

Mezer, S.L. An investigation of the Kenny method of treatment  
1945 of anterior poliomyelitis in terms of physiological psychology

Service  
Paper





BOSTON UNIVERSITY  
SCHOOL OF EDUCATION

LIBRARY

Ed.  
Service  
Paper  
Mezer, S.L.  
1945

The Gift of Sadye L. Mezer





Ed.  
Service  
Paper  
Mezer, S.H.  
1945

BOSTON UNIVERSITY  
SCHOOL OF EDUCATION

AN INVESTIGATION OF THE KENNY METHOD OF TREATMENT  
OF ANTERIOR POLIOMYELITIS IN TERMS OF  
PHYSIOLOGICAL PSYCHOLOGY

Submitted by

Sadye Lurensky Mezer  
(B. S. in Education, Sargent College of Boston University, 1933)  
Head Reconstruction Aide, Boston City Hospital

In partial fulfillment of requirements for  
the degree of Master of Education

1945

First Reader: John M. Harmon, Professor of Education

Second Reader: Howard L. Kingsley, Professor of Education

Third Reader: Eleanor Page Bowen, Assistant Professor Nursing Education



School of Education

Aug. 7, 1945

26151



## TABLE OF CONTENTS

Preface.....	<u>Page</u> <u>1</u>
PART ONE. INTRODUCTION	
<u>Chapter I</u>	
HISTORY OF POLIOMYELITIS.....	1
Early history--Present day knowledge of Infantile Paralysis--The National Foundation of Infantile Paralysis--The Kenny Concept--Statement and Justification of the Study.	
<u>Chapter II</u>	
THE NATURE OF THE DISEASE.....	13
Etiology--Neutralization test--Immunology--Recent studies--Chemical blockade--Epidemiology--Symptomology and course--Treatment--Examination of the spinal fluid--Spinal puncture--The respirator.	
<u>Chapter III</u>	
PHYSIOLOGIC ANATOMY OF ANTERIOR POLIOMYELITIS.....	25
Physiological psychology--The nervous system--The nervous system as a whole--The units of the nervous system--The central nervous system--The nerves as conductors--Receptors of the nervous system, Sensation--Interceptors--Proprioception--The muscular system--Types of muscle tissue--Properties of muscle fibers--Red and white muscle fibers--Muscles and the skeletal musculature--The neuromuscular system--The motor unit--The simple reflex--Reciprocal innervation--Physiologic anatomy of poliomyelitis.	



THE HISTORY OF THE UNITED STATES

Preface.....

PART ONE. THE FOUNDATION

Chapter I

HISTORY OF THE UNITED STATES.....

Early history--Discovery of America by Columbus--  
Settlements--The Pilgrims--The Indians--  
The Revolution--The Constitution--The Union--  
The present day.

Chapter II

THE HISTORY OF THE UNITED STATES.....

History--Discovery of America--Settlements--  
The Pilgrims--The Indians--The Revolution--  
The Constitution--The Union--The present day.

Chapter III

REVISIONS OF THE HISTORY OF THE UNITED STATES.....

History--Discovery of America--Settlements--  
The Pilgrims--The Indians--The Revolution--  
The Constitution--The Union--The present day.



Table of Contents (Cont. -2-)

	<u>Page</u>
PART TWO. THE ORTHODOX METHOD OF TREATMENT OF ANTERIOR POLIOMYELITIS	

Chapter IV

THE "ACCEPTED" ORTHODOX THEORY.....	41
-------------------------------------	----

The theory--Physical therapy treatment--Muscle testing--Muscle re-education--Electrical Testing and stimulation.

PART THREE. THE KENNY METHOD OF TREATMENT OF ANTERIOR POLIOMYELITIS	
------------------------------------------------------------------------	--

Chapter V

THE KENNY "CONCEPT".....	54
--------------------------	----

The Kenny Concept--Pain--Splinting--Muscle spasm  
--The argument--"Mental alienation"--Proprioceptive education--"Mental awareness"--"Muscle substitution and incoordination"--The laws of learning--Muscle re-education--Muscle analysis--Muscle classification and synchronization--The objectives and methods of muscle re-education to produce functional activity--The muscle-name phenomena of motor conduction--The process of learning.

Chapter VI

THE KENNY TECHNIQUE.....	88
--------------------------	----

The Kenny Technique--Position of natural rest in bed--The treatment of spasm or the application of hot fomentations--Muscle testing--The respirator--Massage--Muscle re-education--Classification of muscles--The physical unit.

Chapter VII

SUMMARY AND CONCLUSIONS OF THE STUDY.....	102
-------------------------------------------	-----



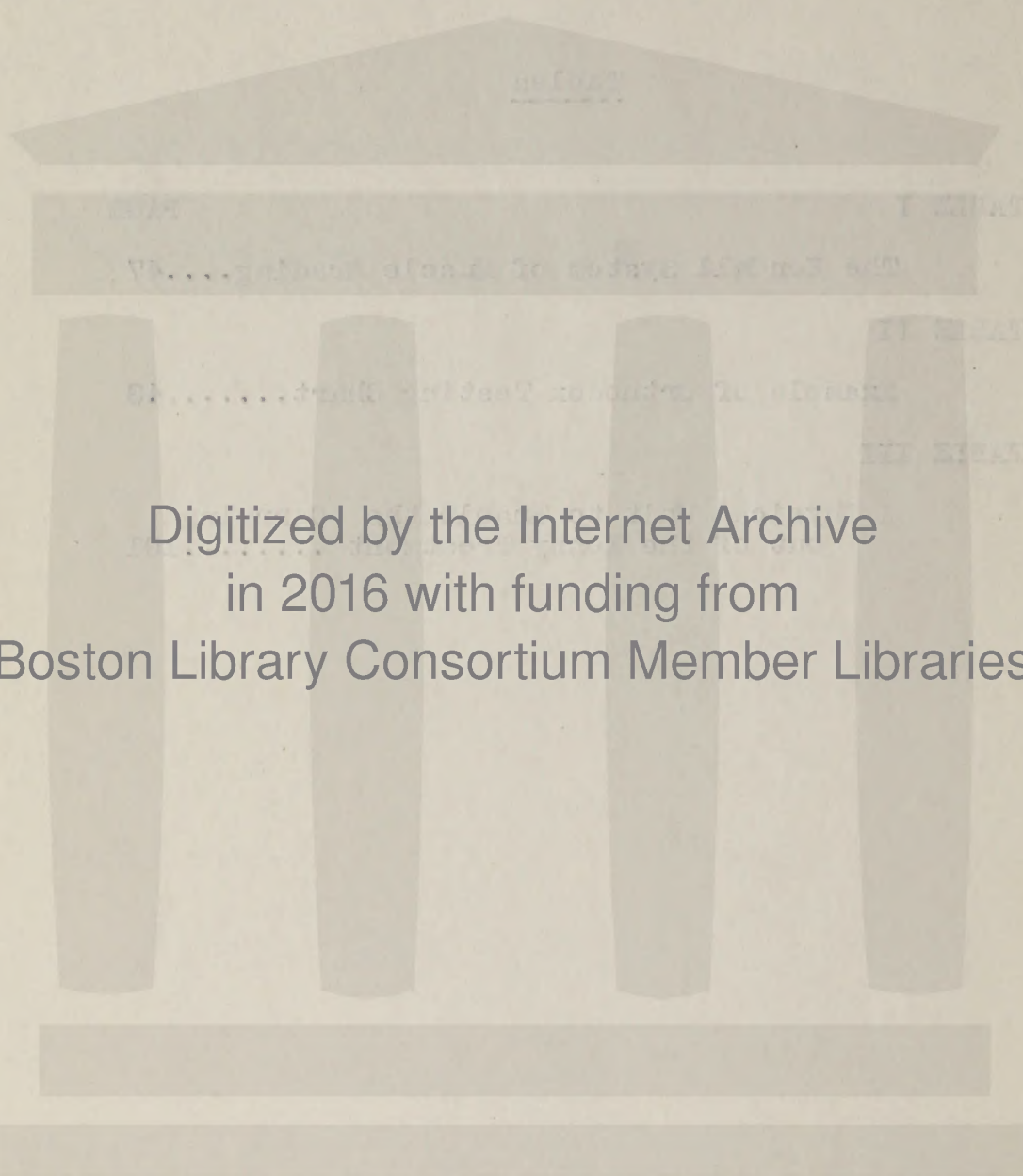




## Tables

TABLE I	PAGE
The Kendall System of Muscle Grading....	47
TABLE II	
Example of Orthodox Testing Chart.....	48
TABLE III	
A Physical Unit to Enable the Carrying out of the Kenny Treatment .....	101





Digitized by the Internet Archive  
in 2016 with funding from  
Boston Library Consortium Member Libraries

<https://archive.org/details/investigationofk00meze>



## PREFACE

" COMPARISON MAY BE HELPFUL; CONTROVERSY LENDS CONFUSION;

CONFUSION BEGETS MISTAKES

COMPARISON IS MADE WHERE IT SUBSERVES ELUCIDATION;

CLARIFICATION AND SIMPLIFICATION

CONTROVERSY IS NOT ENTERED INTO BECAUSE IT SUBSERVES

CONFUSION AND ERROR "

\*

\_\_\_\_ Philip Lewins, M.D.

\*

Associate Prof. of Bone and Joint Surgery  
Northwestern University Medical School, Chicago.







## PREFACE

At the present time, we are not yet ready to prophesy whether the Kenny treatment--altered or unaltered--will remain an accepted method of treating the disease, poliomyelitis. As open-minded, progressive educators in the medical profession, our duty is to investigate and evaluate the new methods of treatment which may be presented to us by research workers. Because our aim, both in education and in medicine, is to be scientific, clinical observation of the Kenny method is not proof enough of its value. Thus, although many observers have reached clinical conclusions, we cannot definitely accept or discard the Kenny treatment of infantile paralysis. An investigation of its worth is indicated and timely. Many articles have been written both pro and con the Kenny method of treatment. The writer agrees with Dr. Philip Lewins, an exponent for the Kenny treatment when he says, "Who knows exactly how quinine cures malaria, or precisely how the sulfonamides cure infections? Parents of polio-children say, 'from the practical point of view, who cares?'"<sup>1</sup>

At this point, the writer must "draw a line" in the above

---

\* Associate Prof. of Bone and Joint Surgery, Northwestern Univ.  
 1. P. Lewins, "The Early Treatment of Poliomyelitis," Illinois Medical Journal, 81: 281, April, 1942.





comparison. Those who oppose Miss Kenny's treatment have said-- and rightly so- "The Kenny treatment does not actually cure the disease." Neither Miss Kenny nor the physicians who are working with her have ever claimed to bring to "life" the muscles which are innervated by completely destroyed and atrophied anterior horn cells. Much unfair judgment of the Kenny treatment has come from those who have not bothered to investigate thoroughly. While the orthodox theory considers all muscle dysfunction due to anterior horn cell pathology, the Kenny theory believes that there are other very important factors which play such an important role in the disease that the amount of residual paralysis may be greatly diminished by proper therapy at the proper time. These conditions Miss Kenny has termed "spasm", "mental alienation", and "incoordination". While it is true that her optimistic attitude seems to ignore the possibility of complete destruction of anterior horn cells, she is not unmindful of it but will not admit its presence until all effort has been made to administer proper therapy and function does not return.

\*

Francis Bacon describes scientific ability as "love of truth, passion for research, power of suspended judgment, accuracy of patient observation, and freedom of preconceived ideas." It is well for all of us in the field of education and in the medical profession to keep this ideal in mind. If we do not base

\*

---

Francis Bacon, Novum Organum, p. 316.





our course on science, our method of action is based upon opinion and guess. Since, psychologically speaking, impartiality is practically impossible,<sup>1</sup> prejudice rules opinion and guess. Science, on the other hand, comes closest to impartiality, for "it imposes certain methodological and logical safeguards and restrictions, which it is impractical or impossible to impose in some other fields,"<sup>2</sup> Before science developed, "authority and tradition were the guides; the doctor cited Galen and Esculapius; the teacher placed reliance in Plato and Quintilian. Science promises the only means of escape from the bondage of tradition and the shackles of authority."<sup>3</sup>

It was with trepidation that the present study was undertaken. The Kenny Concept and Treatment is a highly controversial subject. The writer's aim has been to investigate with objectivity; if it appears to the reader that the writer pays more attention to the Kenny Treatment than to the Orthodox Treatment, it is because this is primarily a study of the Kenny Treatment. Many have criticized Sister Kenny for the obscurity of her terms. The writer has attempted to (1) analyze these terms in order to clarify them and (2) find out what is good in the Kenny Treatment else why does she get such good results that she is winning more and more of the medical profession over to her Concept and Treatment. Of course, it is possible for us

1. E. Freeman, Social Psychology, New York, Henry Holt and Co., 1937.
2. E. Freeman, op. cit., p. 284.
3. J. C. Almack, Research and Thesis Writing, Boston, Houghton Mifflin Co., 1930, p. 116.





to get along and obtain some improvement from nerve and muscle because Nature is good to us; but if we are interested in mankind, and if we ~~take~~ our jobs seriously, we will become familiar with the basic rules of physiology and psychology which lie beneath our methods in order to better understand our treatment and improve upon it.

Sadye K. Mezer





## INTRODUCTION

### PART I

#### HISTORY OF ANTERIOR POLIOMYELITIS





## CHAPTER I

### HISTORY

\*

#### EARLY HISTORY

Acute epidemic poliomyelitis is, by no means, a modern disease, but may be traced back to early Egyptian history, for there is an Egyptian stèle of the eighteenth dynasty which clearly illustrates a shortened and deformed foot typical of poliomyelitis. There is also recognizable reference to the disease in the Bible. In the Old Testament, Mephibosheth, the son of Jonathon,<sup>1</sup> was lame from a paralytic disorder which certain authorities (Osler) consider as poliomyelitis. In the New Testament, Jesus was credited with curing an atrophied arm,<sup>2</sup> possibly due to poliomyelitis.

Although this disease is world-wide in its distribution, one-half the annual incidence of cases has been reported during the past three decades from the North American Continent, especially from the United States. Medical writings from the Northern European countries, including Germany and England, indicate the occurrence of the sporadic form of the disease.

---

\* P. H. Harmon, "Geographical and Racial Incidence of Poliomyelitis," International Bulletin for Economics, Medical Research and Public Hygiene, National Foundation for Infantile Paralysis, Vol. A. 40, 1939, p. 136.

1. II Samuel IV: 5.

2. Mark II:I and III.







# PRESENT DAY KNOWLEDGE OF POLIOMYELITIS

\*

Heine, in 1840, was the first to establish poliomyelitis clinically. More than a century has passed during which time much research and clinical work has been done. Yet the diagnosis and treatment of poliomyelitis presents many problems. During the years which followed, Heine, only those patients with a flaccid paralysis were diagnosed. Finally, Strumpell, in 1884, established the existence of a new type of poliomyelitis which he called the "cerebral type". Patients having this type of the disease presented symptoms of fever, vomiting, severe convulsions, followed by a cerebral type of paralysis with signs of motor irritation.

1

Five years later, Caverly<sup>1</sup> called the attention of the medical world to a very important aspect of the disease--the non-paralytic type of poliomyelitis. Wickman<sup>2</sup>, in 1905, did further study of this type of the disease, and wrote a monograph on "Acute Poliomyelitis" which is considered a real classic. Thus we find that Caverly<sup>1</sup>, Wickman<sup>2</sup>, and others suspected that poliomyelitis could present itself in a very mild abortive form with no clinical signs of involvement to the central nervous system--not even signs of meningeal irritation nor with changes in the spinal fluid which is found in the non-para-

1. C. S. Caverly, "Notes of an Epidemic of Acute Anterior Poliomyelitis," Journal of American Medical Association, 26: 1, 1896.
2. I. Wickman, "Acute Poliomyelitis," Nervous and Mental Diseases Monograph, Series No. 16, 1913.

\*

J. B. Neal, International Bulletin for Economics, Medical Research and Public Health, Vol. A 40, 1939, pp. 13-23.





lytic type. From that time to the present we use the terms "non-paralytic" poliomyelitis and "abortive" poliomyelitis more or less interchangeably. However, not until 1931<sup>1</sup> was the existence of this abortive type proved by Paul and Trask.

These two research workers were able to demonstrate in an outbreak of poliomyelitis in Connecticut that the virus of poliomyelitis was present in the naso-pharynx of certain children who were suffering only from a mild febrile illness with gastro-intestinal or anginal symptoms. They showed further, by neutralization studies of the serum at the acute illness and at a later date, that the neutralizing power of the serum had increased following the illness. Although laboratory methods too expensive for general use are necessary to definitely diagnose this abortive type, it must be admitted that recognition of its existence is important from the epidemiological standpoint.

From this brief description we can see how the conceptions of poliomyelitis have developed over a period of more than a hundred years, from a disease attacking the anterior horn cells of the cord with a resulting flaccid paralysis to a system that may involve various parts of the nervous system, or that may

---

1. J. R. Paul and J.D. Trask, "The Detection of the Poliomyelitis Virus in So-called Abortive Types of the Disease," Journal of Experimental Medicine, 56: 319, 1932.





involve various parts of the nervous system, or that may give rise only to signs of meningeal irritation--the non-paralytic type--or that may be so mild as to escape diagnosis entirely unless recourse is had to extensive laboratory studies. A simple classification of the types of poliomyelitis follows:

1. The abortive type, which cannot be diagnosed except by elaborate experimental studies.
2. The non-paralytic type.
3. The lower motor neuron type, including both spinal and bulbar forms.
4. The encephalitic--rare.
5. The ataxic--very rare.

\*

#### THE NATIONAL FOUNDATION OF INFANTILE PARALYSIS

In January 1938, the National Foundation for Infantile paralysis in the United States was organized. Its purposes were to unify, lead, and direct the fight in every phase of infantile paralysis. Its creation was the result of twelve years of thought and study by those connected with the Georgia Warm Springs Foundation at Warm Springs, Georgia. The Georgia Warm Springs Foundation, in turn, had been organized in 1927 as a non-stock, non-profit organization under the guidance of President Roosevelt.

This creation of a national foundation to unify the fight against this disease had been under consideration for years by those who had watched the ravages of infantile paralysis. For seventeen years now, in that institution, under the leadership of President Roosevelt, serious, painstaking workers study

\* B. O'Connor, International Bulletin for Economics, Medical Research, and Public Health, Vol. A. 40, 1939.





the after-effects of infantile paralysis. It is true that Warm Springs has not taken care of all victims of infantile paralysis; they never claimed to. Although only a small percentage of patients were taken care of there, the work was of such an outstanding nature that all began to look toward Warm Springs for help in attacking this problem. Because some organized group was needed, the National Foundation for Infantile Paralysis sprang into being. The supporting funds came from the "Balls" of the annual celebration of President Roosevelt's birthday.

Originally, the Foundation's work was to aid in the research and study of the Medical problem--not necessarily render aid to individual afflicted cases. However, in 1939, local chapters were organized throughout the United States in the various states so that local relief is now possible. This has enabled the families of the victims of this disease to receive financial assistance when needed. Essentially, however, the funds of the Foundation is directed to the solution of the Medical problem.





## THE KENNY CONCEPT

Elizabeth Kenny, a nurse in the Australian wilderness, was called to see a little girl who lay very ill. As was customary in that wild country, when the nurse could not diagnose her case, she telegraphed the symptoms to the nearest physician who wired back a diagnosis with instructions on how to treat the malady in question. To Miss Kenny's telegram to Dr. Aeneas McDonnell came the reply: "Infantile paralysis. No known treatment. Do the best you can with the symptoms presenting themselves. Dr. Aeneas McDonnell." Sister Kenny writes, "Fortunately, I was completely ignorant of the orthodox treatment of the disease itself. The obvious agony of the little golden-haired patient called for immediate action of some sort. I set to work at once to relieve the distress. I knew the relaxing power of heat. I filled a frying pan with salt, placed it over the fire, then poured it into a bag and applied it to the leg that was giving the most pain. After an anxious wait, I saw that no relief followed the application. I then prepared a linseed meal poultice, but the weight caused pain. At last, I tore a blanket made from soft Australian wool into suitable strips and wrung them out of boiling water. These I wrapped around the poor tortured muscles. The whimpering of the child ceased almost immediately, and after a few more applications





her eyes closed slowly and she fell asleep."<sup>1</sup> This incident stimulated the birth of the Kenny Concept and Treatment.

The trail was not an easy one. Medical men branded her a heretic, but in spite of the obstacles put in her path, her perseverance and steadfastness of purpose led her on to prove her theory to the medical world. One by one, clinics were set up for her by the Australian government and finally a school was begun to train physiotherapists in her technique. In 1936, a Dr. Schwartz came to her from France with his child who had been afflicted with infantile paralysis. The child apparently improved and when Dr. Schwartz was leaving Australia, he persuaded Sister Kenny to visit them in France. Thus it was that Miss Kenny came to France, and, later on, to England in 1937.

The London County Council agreed to "listen to her" and began a scientific investigation of her method. They reported, "Apart from a few cases of contracture of the achilles tendon, which was overcome later, patients developed no contractures while they were recumbent and well supervised. Her method of keeping limbs in a neutral position without splints when the patient was in bed is therefore not harmful in the early stages of the disease. On the other hand, the Council is definitely of the opinion that when a muscle is recovering, splints are often

---

1. Elizabeth Kenny, And They Shall Walk, New York, Dodd, Mead, and Company, 1944, p. 24.





useful in prevention of over-fatigue and deformity. In the one year period, the Committee saw nothing to justify Miss Kenny's belief that in two or three years her patients will not require artificial aids and having sufficient useful function, will not require surgical supervision of after-care. They do not consider that she has faced the problem of residual paralysis. If, therefore, Miss Kenny has claimed to be able to cure poliomyelitis completely, the Committee finds that claim is in no way substantiated.<sup>1</sup>

Sister Kenny eventually came to the United States, and after visiting several clinics settled in Minneapolis, for the National Foundation for Infantile Paralysis became interested and made arrangements with the University of Minnesota Medical School to study the Kenny method. Thus, under the guidance of the Orthopedic and Physiotherapy Departments of the University, the Minneapolis General Hospital was made ready for this study.

From that time, June 1941, to the present, the Kenny method has been administered and studied in two hospitals--the above-mentioned Minneapolis Hospital and the University Hospital --where Miss Kenny and her assistants from Australia have had many visitors from all sections of the country. After the sceptical trial period, some two years ago, a training course in the Kenny technique was offered. Many physicians and physio-

---

1. "Report of the Committee Appointed to Observe the Kenny Method of Treatment for Paralysis at London," The Medical Journal of Australia, Vol. II, pp. 1133-1137, Dec. 31, 1938.





therapists have taken this course--many of them ardent "orthodox" pioneers. During this time, funds from the National Foundation of Infantile Paralysis have enabled extensive study of this method so that, should Miss Kenny go back to Australia, the Physiotherapy Department of the University of Minnesota may be able to continue teaching the Kenny method.

1  
An editorial in the American Medical Association Journal stated, "It is the opinion of this Committee on Research for the Prevention and Treatment of After-Effects of the National Foundation for Infantile Paralysis, after a study of the workers at the University of Minnesota, that during the early stages of infantile paralysis, the length of time during which pain, tenderness and spasm are present is greatly reduced and contractures caused by muscle shortening during this period are prevented by the Kenny method. The general physical condition of the patients receiving this treatment seems to be better than that of patients treated by some of the other methods during a comparable period."

#### STATEMENT OF JUSTIFICATION OF THE STUDY

From the time of the introduction of the Kenny Concept and Treatment of Infantile Paralysis to the present, medical literature has been studded with comment both pro and con

- 
1. Editorial, Journal of American Medical Association, 117: 2171-2172, December 20, 1941.





the Kenny Method. After having delved extensively into this literature, it becomes apparent that, in general, those who are impressed by Miss Kenny's treatment and results are those who have observed her work first hand, while those who condemn her are "arm-chair" philosophers. Miss Kenny has to her credit (or discredit) three books which were published in the United States. She admits that her early books presented findings, but these findings were not all scientific. Now after two years of study of the Kenny Treatment in operation, the third book is published--written by Dr. John F. Pohl (Clinical Assistant Professor of Orthopedic Surgery, University of Minnesota; Attending Orthopedic Surgeon, Minneapolis General Hospital) in collaboration with Sister Elizabeth Kenny. A Foreword by Dr. Frank R. Ober (President, The American Orthopedic Association: John B. and Buckminster Brown Clinical Professor of Orthopedic Surgery, Harvard Medical School) states,<sup>1</sup> "....If the Kenny technique, with its continuous superb nursing, is followed, the physician will find that the affected parts become soft and relaxed, limitation of motion is not so persistent, and pain subsides remarkably early as compared with other methods. ....It is my personal belief that this book should be perused and used by all interested

---

1. J. F. Pohl and E. Kenny, The Kenny Concept of Infantile Paralysis, Minneapolis, Minn., Bruce Publishing Co., 1943.





in the welfare of those who are afflicted with poliomyelitis."

Now while it is true that it is not scientific to pursue a procedure because of the approval of "authority," it is also not scientific to hold to "tradition" for tradition's sake. No one who knows of the fine records of Doctors Ober and Pohl can truthfully say that they are not qualified to pass sound judgment. They are both conservative, scientific medical men who were open-minded enough to "hear" something new. If they, with their many years of experience in the orthodox treatment of poliomyelitis are impressed after two years of observation--then, we should "sit up" and shake off the "shackles of tradition." We should try to understand the Kenny Treatment and find out what is good about it that more and more medical men are being impressed favorably. If she is getting "results," WHY?

Few of us have not seen the heartbreaking results of the disease, Infantile Paralysis. We have all seen victims who were more or less affected. Those of us who have loved ones in the child-age group turn away with thankfulness and a prayer in our hearts to God that our children were spared. Medicine must admit that results from our orthodox treatment have been far from perfect. Our treatment has, it is true, returned many victims to a normal or fairly normal life. If, however, we can improve on that quota by decreasing the amount of paralysis of the chronic stage--let us be open-minded enough to change our ideas and therapy.





The "problem" of the disease, Infantile Paralysis, is manifest in the twisted bodies and, in many cases, twisted personalities, which are left behind by the ravages of the disease. It is apparent and unquestionable. The "justification" of this study is a love of truth and a desire to better serve humanity.

Although we still have far to go to conquer the disease, the investigation reveals that many extensive studies have been made to develop the etiology, immunology, and pathology of the disease, poliomyelitis. Such extensive work has also been done to develop the means of neutralizing antibodies in the serum.

There are two schools of thought concerning the question of the portal of entry of the virus. One school holds that the digestive tract is the major portal of entry. This school is divided into two groups, one of which believes that the virus is divided into two groups, one of which is believed to be the cause of the central nervous system and that the early symptoms are due to the general infection. The second group believes that the virus travels directly to one of the sympathetic ganglia in the central nervous system; the second school of thought, which is held by the larger, believes that the virus enters the central nervous system directly from the nasopharynx, particularly by the olfactory nerve.

Comparatively recently, the virus of poliomyelitis was





## CHAPTER II

### THE NATURE OF THE DISEASE

#### ETIOLOGY \*

Although we still have far to go to conquer the disease, an investigation reveals that many extensive studies have been done to develop the etiology, immunology, and pathology of the disease, poliomyelitis. Much outstanding work has also been done to develop the status of neutralizing antibodies in the serum.

There are two schools of thought concerning the question of the portal of entry of the virus. One school believes that the digestive tract is the major portal of entry. This school is divided into two groups, one of which believes that the virus is more or less generally distributed before it localizes in the central nervous system and that the early symptoms are due to the general invasion. The second group believes that the virus travels directly by way of the sympathetic fibers into the central nervous system. The second school of thought, which is perhaps the larger, believes that the virus enters the central nervous system directly from the nasopharynx, particularly by the olfactory nerve.

Comparatively recently, the virus of poliomyelitis was

---

\* J. B. Neal, op. cit.







found in the faeces of an abortive case of poliomyelitis twenty four days after the onset of a mild illness by Trask, Vignex, and Paul.<sup>1</sup> They do not claim that the virus necessarily enters the body through the gastro-intestinal tract but they do emphasize the importance of the stool as a method of exit. "Such facts suggest that during an epidemic of poliomyelitis these common, mild and often unrecognized forms of the disease may be responsible for a high degree of pollution of sewage with poliomyelitis virus."

\*

#### IMMUNOLOGY

Prophylactic measure in a disease with so low a morbidity as that of poliomyelitis necessitates a great deal of time and study. To increase the problem is the fact that today an older group is attacked by the disease, and it is apparent that the period of greatest incidence has extended to the older age groups. Twenty-five years ago one could have confidently stated that the period of greatest incidence was between the ages of two to five years.

Reasoning from the results with convalescent measles serum during the incubation period (measles being also a virus disease), one of the first measures to be adopted was the intramuscular administration of convalescent serum or normal adult blood to children known to have been exposed. Although there seemed to be some logic in this method, the protection proved only transient and results to date have not been convincing.

In 1935, efforts to prepare a vaccine to produce immunity

---

1. J. D. Trask, A. J. Vignes, J. R. Paul, "Isolation of Poliomyelitis Virus from Human Stools," Proceedings, Society Experimental Biology and Medicine, 38: 147, 1938.

\* J. B. Neal, op. cit.







were made. In the fall of that year, however, the use of the poliomyelitis virus for human vaccination was advised against by the Medical Director of the Public Health Service in Washington. Its use has, therefore, been discontinued until a vaccine can be prepared that is acceptable both from a standpoint of safety and efficiency.

#### RECENT STUDIES<sup>\*</sup>

It has been observed by many investigators that the disease, poliomyelitis, occurs in individuals of a certain constitutional type. The question arises: does the endocrinological nature of an individual make him susceptible or immune to the disease? In 1789, Michael Underwood of London wrote a description of poliomyelitis in which he pointed out its occurrence in the "finest children." In 1840, Heine wrote, "Among features prominent in almost every case are the strong and blooming bodily constitution of the patient". There are many descriptions in medical literature of the exceptionally robust and active children as victims of the disease. In 1917, Draper<sup>1</sup> ventured the opinion that the disease tends to occur in individuals of certain constitutional type.

Recently, the study of the role of vitamins and certain hormones was pursued. This research work shows a certain relationship of the vitamins and certain of the hormones; for ex-

---

1. G. Draper, Acute Poliomyelitis, Philadelphia, P. Blakes-ton's Sons and Co., 1917.

\* J. B. Neal, op. cit.

W. L. Aycock, "Epidemiology of Poliomyelitis," International Bulletin.





ample, that vitamin C is elaborated in large quantities in the adrenals. Fascinating as these studies are and important as they may prove to be, it is far too early to warrant a definite statement in regards to their value in either prophylaxis or treatment.

Another method of prevention which was tried is chemical blockade. This method is based on the theory that the portal of entry of the virus is through the olfactory region of the naso-pharynx. If this is so, the application of certain chemicals should make the mucous membrane impermeable to the virus. In spite of the fact that results with experimental work in monkeys have been excellent, results with children during epidemics have not come up to expectation. There was an epidemic of poliomyelitis in Toronto in 1937. Chemical blockade was experimented with there on a rather extensive scale. 4713 children were treated; a control group of 6300 children were not treated. There were 11 cases of poliomyelitis in the former group and 18 cases of poliomyelitis in the latter group. Although this may or may not have been permanent, it was admitted that 25% of the treated children lost the sense of smell.

It is apparent from this study that some way should be found to distinguish the immune from the susceptible as in diphtheria. Otherwise, this method, or any other, is difficult to apply during an epidemic in a large city.





Much research work is still in the experimental stage.  
<sup>1</sup>  
 Kramer, Grossman, and Parker did an experiment, which they reported on, in which they injected pituitrin and adrephine (a mixture of adrenalin and ephedrine sulphate) into the nasal mucous membranes of monkeys. They concluded that monkeys may be protected against intra-nasal infection and intra-cerebral inoculation of the virus. They found protective antibodies in the blood and a cellular response in the mucosa in which eosinophils were prominent.

Experimentation and research are going on at the present time. A few studies which were reported in recent literature follow:

"Sulfonamides of No Value in Treatment  
 of Poliomyelitis," by John A Toomey,  
 (Western Reserve Hospital)

<sup>2</sup>

Here, the author warns against the use of sulfonamides in treating poliomyelitis. Also Penicillin proved ineffective although it did not cause any harm.

"Ultraviolet Irradiation of Blood in the  
 Treatment of Experimental Poliomyelitis in  
 Monkeys," by John A. Toomey and W. S. Takacs.

<sup>3</sup>

1. S. D. Kramer, L. M. Grossman, G. C. Parker, "Acute Immunity to Experimental Poliomyelitis by Intranasal Route in Macacus Rhesus," Proceedings Society Experimental Biology and Medicine, 36: 370, 1937.
2. J. A. Toomey, "Correspondence," Journal American Medical Association, 126: 49, September 2, 1944.
3. J. A. Toomey, W. S. Takacs, American Journal of Diseases of Children, 66: 605-606, December, 1943.





Here, on experimental work on monkeys, the authors found that ultra violet irradiation of blood did not modify the disease.

Although we have made progress in our research of poliomyelitis, we are still very much in the experimental stage.

\*

#### NEUTRALIZATION TEST

There is evidence that one attack of poliomyelitis confers a lasting immunity. In 1910, A. Netter and C. Lavaditi, French research workers found that an addition of immense serum could neutralize an effective dose of the virus. This test has been of invaluable aid in the study of the epidemiology of the disease. If the neutralizing property of serum can be taken as evidence of acquiring immunity, it would seem that in spite of the absence of any history of poliomyelitis, such individuals have at some time acquired the virus which has produced in them an immunity, either sub-clinically or without recognized signs of the disease. Therefore, the actual distribution of the poliomyelitis virus should be revealed by a study of the neutralizing power of the blood serum of a sufficiently large number of persons.

1

Aycock and Kramer have shown that the incidence of poliomyelitis is low in infants under one year. This is probably due to a passive immunity transmitted through the placenta to the bodies of the young. The authors did neutralization tests

---

\* W. L. Aycock, op. cit.

1. W. L. Aycock, S. D. Kramer, "Immunity to Poliomyelitis in Mothers and the Newborn as Shown by the Neutralization Tests," Journal Experimental Medicine, 52: 457, 1930.





on the blood serum of urban mothers and their newborn infants. They found immunity to be present in ten out of twelve mothers and in ten out of twelve infants, with complete correspondence between mother and infant.

<sup>1</sup>  
The same authors also tested the blood sera of seventy-five individuals of all ages who had never had an attack of poliomyelitis. Twenty-nine lived in rural districts; forty-six were residents of urban communities. Only six of the sera of rural dwellers neutralized, while thirty-two of the city dwellers were protected. That there is widespread dissemination of the virus in Southern climates is also corroborated by the neutralization test.<sup>2,3</sup>

\*

#### EPIDEMIOLOGY

The epidemiology of poliomyelitis is based upon a complex interaction between the virus and human host. There are paracitic, environmental, and autarceologic factors involved. Although poliomyelitis is an infectious disease, it is not a contagious disease for it has been observed that poliomyelitis

- 
1. W. L. Aycock, and S. D. Kramer, "Immunity to Poliomyelitis in Normal Individuals in Urban and Rural Communities as Indicated by the Neutralization Test," Journal of Preventive Medicine, 20: 41, 1930.
  2. Aycock and Kramer, "Immunity to Poliomyelitis in a Southern Population as Shown by the Neutralization Test," Journal of Experimental Medicine, 50: 201, 1930.
  3. M.N. Soule, and E.B. McKinley, "Neutralization of Virus of Poliomyelitis with Serums of Healthy Porto Ricans," Proceedings Society Experimental Biology and Medicine, 29: 268, 1931.
- \* W. L. Aycock, International Bulletin.





shows but little tendency to spread in the household.<sup>1</sup> Although it is exceptional when exposure to a previous case can be traced, observations of the occurrence of poliomyelitis reveal a general space and time relationship between cases.

The concept of the geographical distribution of the disease has been changed because of the improvement in reporting of cases. In the north temperate zone, where the disease is best known and where it is thought to have reached a maximum, the number of cases increase in the summer months (July and August), attain a peak from August to October and then diminish steadily to a minimum in the late winter and spring. Comparatively severe outbreaks have been recorded in such places as Iceland, Greenland, and Alaska where the sparsity of population must be considered. The tendency is toward more even distribution throughout the year as the warm climates are approached. Thus we find that the existence of poliomyelitis may be traced much the same as other common infectious diseases, that it is now known to occur in all quarters of the globe, and that its incidence varies markedly with latitude, both north and south of the Equator.

Rare instances have been reported where operations on the mucous membranes of the upper respiratory tract have exerted

---

L. W. L. Aycock , and P. Eaton, "The Epidemiology of Infantile Paralysis. Relation Between Cases in the Same Family," American Journal Hygiene, 5: 624, 1925.





an influence on the occurrence of poliomyelitis.<sup>1</sup> A causal relationship is thought to exist because of the number of cases of the bulbar type which have followed tonsillectomy and adenoidectomy by an interval corresponding to the incubation period of the disease. It is thought that a pathway of infection different from the usual route is opened up by the operative procedure. Transmission through milk is exceptional and plays only a small part in the epidemiology of the disease.<sup>2</sup>

#### SYMPTOMOLOGY AND COURSE \*

From our somewhat limited knowledge, the incubation period is believed to be from 7 to 14 days. It is rarely less than 6 or more than 18 days.

Except for the abortive, all types of the disease have much the same initial symptoms. The early symptoms are headache, fever, vomiting, constipation or diarrhea, and frequently congestion of the throat and pharynx. The temperature is usually 100 to 103 F, although it may be as high as 104 and 105 F. It usually lasts from 4 to 5 days or longer and falls by lysis. It has no characteristic curve. A second elevation of temperature occasionally occurs, but this is not always accompanied by an extension of paralysis. There is usually a pulse rate which is in proportion to the fever. If there is a much more rapid rate, it may be an indication of an early bulbar involvement. This rapid rate frequently forecasts a poor prognosis.

There are three types of onset. In the first and largest

1. W. L. Aycock, E. W. Luther, "The Occurrence of Poliomyelitis Following Tonsilectomy," New England Journal of Med., 200: 164, 1929.
2. W. L. Aycock, "A Milk-borne Epidemic of Poliomyelitis," American Journal of Hygiene, 7: 791, 1927.

\* J. B. Neal, op. cit.





group, the symptoms progress rapidly and uninterruptedly. In the second and smaller group of cases, there is a period of remission in the development of the disease. In the third and smaller group, paralysis may develop without premonitory symptoms. These symptoms may be quite as severe in the non-paralytic as in the paralytic form. In the majority of cases the onset is very abrupt, but there are rare cases of insidious onset.

Pain is an almost constant symptom of the early stage and varies greatly in its severity. There is often pain in the neck, back and abdomen. Headache occurs in a large percentage of cases. Occasionally sedatives and even opiates are necessary to control it. Hyperesthesia is another early symptom which may be quite general and elicited by the slightest touch of the extremities. It is usually more marked along the spine and over the large nerve trunks and is demonstrated by somewhat deep pressure. Hypoesthesia and anesthesia almost never occur in poliomyelitis. In general, the duration of the pain is short, but the neuritic pains may persist in convalescence.

A symptom of some value is drowsiness alternating with irritability when disturbed. Occasionally, this drowsiness may progress to a state of semi-stupor lasting for several days. Other meningeal symptoms occurring early are: antero-posterior stiffness of the neck and back--often a Kernig's sign. Caverly,<sup>1</sup>

---

1. C. S. Caverly, "Preliminary Report of an Epidemic of Paralytic Disease Occurring in Vermont, in the Summer of 1894," Yale Medical Journal, 1:1, 1894.





in 1894, noted the stiffness of neck and numerous writers in medical literature have emphasized the importance of this symptom since that time. Convulsions and delirium rarely occur.

The kidneys and bladder may be affected. There may be incontinence or retention of urine. When there is difficulty in voiding, catheterization may have to be done.

The neurological signs are very important because of the changes in the reflexes. Although a Babinski or an ankle clonus may be found, the pupils are usually equal and the pupillary reflexes are almost always normal. However, early in the disease the deep reflexes are usually exaggerated and equal.

It is not easy to describe the symptoms of this disease because epidemics vary in nature and severity both in individuals who are attacked and in the different epidemics. Usually paralysis develops on the second or third day of the disease. In the "dromedary" type, however, it may not set in until the eighth day or even later. Paralysis sometimes reaches its maximum almost immediately; sometimes, it comes on in a slow manner--from a few hours to two or three days.

\*

#### TREATMENT

Unfortunately, there is not yet any specific treatment for the actual disease of anterior poliomyelitis. Convalescent serum has already been discussed, but there are still some medical men who believe in it.

Concerning the examination of the spinal fluid: The spinal fluid is usually increased in amount and shows an in-

---

\* J. B. Neal, op. cit.





creased cell count. Protein is usually slightly to moderately increased and the sugar is normal or high. Because the findings of the spinal fluid examination may be found to be within normal limits, a definite diagnosis of poliomyelitis cannot be made by such an examination alone. However, certain other diseases may be ruled out.

Spinal puncture is done if there are signs of meningeal irritation as well as for examination of the spinal fluid. The pressure may thus be relieved. In some cases, this procedure must be carried out a few times. However, in cases of **severe** bulbar paralysis, the physician must exercise great care in withdrawal of the fluid. Indeed, in some cases, it is best not done at all. Sometimes, hypertonic glucose or sucrose intravenously gives some relief from the increased pressure or oedema of the brain.

According to the orthodox treatment of poliomyelitis, if respiratory paralysis occurs, a respirator should be used. Of course, the Kenny method outlaws the respirator. We know, however, that the respirator does not always help in these bulbar paralysis patients. The fatality is high. Too often the patients get an upper respiratory infection--especially pneumonia.





## CHAPTER III

## PHYSIOLOGIC ANATOMY OF ANTERIOR POLIOMYELITIS

In order to better understand the pathology and treatment of any disease it is necessary to build a foundation. The foundation of a study of the pathological manifestations of a disease rests upon the findings of the studies of normal human functions of the body--anatomy (the science of the structure of the animal body and the relation of its parts), physiology (the science which treats of the functions of the living organism and its parts), and psychology (that branch of science which treats mind and mental operations especially as they are shown in behavior).

PHYSIOLOGICAL PSYCHOLOGY

Physiological psychology is a science which includes physiology, psychology, and neurology. Although it includes each, it lies between them--so to speak--thus, is not paramount to either one or another.<sup>1</sup> The major interest of physiological psychology is the behavior of Man which differentiates him from the lower animals. The study of physiological psychology leads directly to the nervous system which has to do with integrating and coordinating the activities of the various parts of the body.

We must also recognize that the blood as well as the nerves

1. C. T. Morgan, Physiological Psychology, New York and London, McGraw-Hill Book Company, Inc., 1943.





is an integrator, for it too connects every part of the organism with every other part.

The function of the circulatory system is to bring nourishment to the various parts of the body and to carry away waste products to organs of elimination. The hormones, which are substances excreted into the blood stream by the endocrine glands, excite and depress other bodily tissues and help form an organic background.<sup>1 2</sup> Thus, having touched generally upon the circulatory system, we approach the neuromuscular system which includes (1) the nervous system, (2) the muscular system.

3

### THE NERVOUS SYSTEM

The nervous system as a whole. Since the adjustment of the various parts of the body is based upon the function of the nervous system, we should review some of its essentials. Physiologists very often compare the nervous system with a telephone or telegraph system. The receiving stations are the sense organs. The nerves are the wires which lead to "telephone central"--the spinal cord and the brain. There are thirty-one pairs of nerve bundles which lead to the spinal cord and brain. The pathways which run toward the brain are called sensory nerves or sensory pathways. Those that run from the brain are called motor nerves. Sensory fibers enter at both sides of the

---

1. W. B. Cannon, The Wisdom of the Body, New York, The Norton Press, 1932, p. 309.

2. C. T. Morgan, op. cit.

3. J. B. Morgan and A. R. Gilliland, An Introduction to Psychology, New York, McMillan Co., 1927.





cord and motor fibers leave from both sides. Both sensory and motor fibers are bound together in common bundles.

Thus, although a working analogy between the nervous system of the body and the telephone system of a city may be made, in one respect this analogy does not hold true. The messages of the nervous system run only in one direction: the sensory, toward the brain; the motor, from the brain. The peripheral nervous system, therefore, includes sensory fibers, which pass from the receptors to the central nervous system and motor fibers, which pass from the central nervous system to the effectors.

#### THE UNITS OF THE NERVOUS SYSTEM

The central nervous system. Structurally, the central nervous system is made up of the spinal cord and the brain. The spinal cord is relatively simple. We have thirty-one pairs of nerve bundles branching off the spinal cord. The brain, however, is very complex and consists of the medulla, pons, cerebrum, cerebral cortex, thalamus, and many other parts. It is the great adjusting center of the organism.

The Neurone. Like all the rest of the body, the nervous system is made up of cells. A nerve cell with all its branches is called a neurone. There are two types of branches connected with each nerve cell; the dendrite or receiving type, and the axon or sending type.

Types of Neurones. There are three types of neurones: sensory, motor, and the central or coordinating neurone. At least two of these types is involved in the simplest use of the



could not have been left. I have found both sides. Both sensory and motor fibers are found together in common bundles.

Thus, although a working analogy between the nervous system

and the body and the relationship of a cell may be made,

in one respect this analogy does not hold true. The responses

of the nervous system run only in one direction: the sensory

toward the center, the motor, from the brain. The peripheral

nervous system, therefore, includes sensory fibers, which pass

from the receptors to the central nervous system and motor fibers

which pass from the central nervous system to the effectors.

#### THE UNIT OF THE NERVOUS SYSTEM

The central nervous system, specifically, the central

nervous system is made up of the spinal cord and the brain.

The spinal cord is relatively simple. It has a butterfly-like

of nerve bundles branching off it. The brain, on the other

hand, is very complex and consists of the cerebral cortex,

cerebellum, brain stem, and many other parts. It is the

most important part of the organism.

The Nervous System. Like all the rest of the body, the nervous

system is made up of cells. A nerve cell with all its branches

is called a neuron. There are two types of neurons: multipolar

and bipolar. Each nerve cell has a characteristic shape, and the

shape of each is different.

Types of Neurons. There are three types of neurons:

sensory, motor, and an intermediate or association neuron.

Each type of neuron is involved in the transfer of the

nerve mechanism.

The Synapse. Nerve cells are connected with each other by a meshwork of dendrites and axons. This junction between neurones is called a synapse, which signifies a "fitting together."<sup>1</sup>

Thus we find we have sense organs, sensory neurones, called afferent (carrying to) or sensory fibers, the nerve center, the motor (carrying away from) or efferent fibers and the muscle.

The nerves as conductors.<sup>2</sup> Between the central nervous system and the end organs we have the nerves. Nerves possess the characteristic of conduction, for if an excitation is started at any point in the nerve, there is a conduction of this commotion in both directions. Therefore, we may say that an excitation is necessary to begin the process of conduction. "General stimuli" of the nerves may be classed as follows: chemical, thermal, mechanical, and electrical. Nerves are effected by chemical substances--acids more so than bases. The sudden heating of a nerve acts as a stimulus. Pinching the nerve or dropping a light weight on it are examples of mechanical stimulation. The fourth effective agent may be illustrated by electric shocks in the form of induced currents. Since these stimuli effect the nerves, and because the nervous system and the circulatory system are integrators, we find that muscles and glands are also effected by such stimuli.

1. J. B. Morgan and A.R. Gilliland, An Introduction to Psychology, New York, McMillan Co., 1927.
2. G. T. Ladd and R. S. Woodworth, The Elements of Physiological Psychology, Second Edition, New York, Charles Scribners Sons, 1911, p.127.





As has been stated, when a nerve is stimulated at any one point, it has the property of conducting in both directions. This is called double conductivity of nerve fiber. Although this phenomena is difficult to understand, it has been proved in experimental work. Under normal conditions, we know that motor nerves receive their stimuli in the cord and conduct outward--in one direction--to the muscles. Since most nerves are composed of partly motor fibers and partly sensory fibers, this phenomena is not easy to explain. However, the galvanometer indicates that excitation of a sensory route is capable of causing an outward-traveling impulse, and excitation of a motor nerve is capable of causing an inward-traveling impulse.

Evidence also goes to show the practical indefatigability of nerve fiber. If catabolism takes place, as in the case of muscle fiber, the nerve should fatigue and there should be some signs of oxidation present. Yet, physiologists have applied instruments capable of detecting a rise in temperature of 1/5000 of a degree centigrade and have failed to find any sign of catabolism. Bowditch, <sup>(1)</sup> in a study to determine nerve property, proved that several hours of continuous stimulation did not exhaust the nerve, that it is capable of taking many times more activity than muscle fiber. We do know that oxygen is

---

1. G. T. Ladd, R. S. Woodworth, op. cit., p. 136.





is necessary for nerve stimulation, for evidence has also shown that several hours confinement in an environment free from oxygen destroys the excitability of a nerve. It has also been demonstrated that the admittance of oxygen into the atmosphere promptly restores the excitability of the nerve. However, since an inactive nerve gets out of condition in the absence of oxygen, it is questionable whether it is the activity of the nerve which demands the oxygen.

Any stimulus to a nerve must have the property of suddenness to be effective. For example, a slow change in temperature does not excite the nerve. Very gradual increasing pressure may crush the nerve without exciting it. An example of this is "Saturday Night Palsy" which is a condition we often see in our physiotherapy department. It is too often the result of falling asleep on a chair with the elbow flexed resting on the arm of the chair, head in hand--dead drunk. To act as stimulus to nerve, the electric current must also possess the characteristic of suddenness.

Experimental study also shows that another characteristic of nerve is its very short "refractory period." "The refractory period is that period in which an organ which has been excited by a stimulus is apt to be inexcitable by another stimulus."<sup>1</sup>

---

1. H. C. Warren and L. Carmichael, Elements of Human Psychology, Boston, Houghton Mifflin Co., 1930, p. 41.





Physical and chemical agents also effect the conductivity of the nerve. Cooling a nerve slows its rate of conductivity; warming it, within narrower limits, hastens its conduction. The electric current also interferes with its conductivity. When chemical agents such as the anaesthetics, ether, chloroform, and alcohol are applied to a nerve, conductivity is lowered and may be entirely abolished.

The nerve is, therefore, a quick acting organ whose response is prompt and brief. It is best excited by a sudden stimulus, and after the response, is soon ready for another stimulus. The speed of conduction is so swift that a prediction was once made that the speed of nerve conduction would never be ascertained. This statement was made by Johannes Muller, an eminent physiologist. However, Helmholtz in Germany in 1850 conducted some research from which he made the deduction that the rate of nerve conduction is 100 feet per second. His work<sup>1</sup> has often been repeated and found reliable.

#### RECEPTORS OF THE NERVOUS SYSTEM-- Sensation

The skin surface is filled with sense organs which are so small that they are not visible with the naked eye. There are five kinds of sense organs: (1) temperature; (2) pain; (3) touch; (4) pressure; (5) proprioception or sensation of movement. Not all parts of the body have the same sensitivity,

---

1. G. T. Ladd and R. S. Woodworth, The Elements of Physiological Psychology, Second Edition, New York, Charles Scribners Sons, 1911, p.127.





some parts being more sensitive than others. Experimental study has shown us that the combination of cold and pain gives us the sensation of extreme cold--that the combination of pain, warm, and cold gives us burning hot--and that pain is a common element of hot and cold. There are about twice as many pain end organs as all the others together, as can be proven by subjective experience. Pain can be aroused in almost all places of the body.<sup>1</sup> Thus we come to the sense of movement or proprioception which we shall dwell on at greater length, for one of the points of the Kenny treatment is based upon its principles.

The interceptors consist of sensitive nerve endings of the internal membranes and are the receptors for internal pain and hunger. The proprioceptors is a second group of internal receptors, and are of two types: those which regulate the maintenance of posture and bodily attitudes, and those concerned with equilibrium. The proprioceptors are located in the muscles, tendons, and joints. It is the tensions and contractions of muscle fibers and tendons and the pressure and friction of the joint surfaces which are the stimuli of the kinesthetic receptors. To acquire a motor skill, whether complex or simple, one group of muscles involved contract--this stimulates the kinesthetic receptors, which, in turn, become conditioned stimuli for the next series of muscle contractions. Thus, we may

---

1. J. B. Morgan and A. R. Gilliland, An Introduction to Psychology, New York, Macmillan Co., 1927, p.118.





say that bonds exist between series of responses. It is through these receptors that we have our "muscle sense". That is why it is not necessary for us to look to know the position of the different parts of the body. Tabes Dorsalis is a disease which affects the sensory or afferent nerves. Although the efferent or motor nerves are unaffected and impulses are able to reach the muscles of the lower extremities, the return impulses from the kinesthetic receptors of the activated muscles are not functioning. This results in a characteristic, peculiar, incoordinated gait which greatly resembles a normal individual trying to walk with both feet "asleep". This illustration is presented to point out the importance of this sense of movement or proprioception. The blood vessels of the body are also supplied with nerve endings which are thermal receptors as well as kin-<sup>1</sup>esthetic receptors.

Anatomy."In the spinal nerves, the proprioceptive fibers are mingled with the cutaneous fibers from the same part. After entering the spinal cord, by way of the dorsal route, the fibers carrying impulses from the muscles, tendons, and joints converge to form well-defined ascending tracts (fasciculus gracilis and fasciculus cuneatus) in the dorsal white column upon the side of entry. The spinal pathways terminate in the nuclei gracilis and cuneatus at the level of the medulla. From here new tracts

---

1. M. Muse, A Textbook of Psychology, Fourth Edition, Philadelphia and London, W. B. Saunders Co., 1939, p. 102.





conduct the excitations to the cerebrum and cerebellum. Impulses passing to the cerebrum from the fasciculus gracilis and the fasciculus cuneatus are carried by the internal arcuate fibers, the medial lemniscus, and the thalamocortical radiations from the ventral and lateral thalamic nuclei to the parietal lobe. Impulses are conveyed to the cerebellum by way of the external arcuate fibers and the spinocerebellar tracts. These tracts are closely related to the efferent centers of the cerebellum and so help to regulate the motor responses of the organism".<sup>1</sup>

#### THE MUSCULAR SYSTEM

Types of muscle tissue. There are three types of muscle tissue: smooth, cardiac, and striated. The autonomic system controls the smooth, cardiac, and gland tissue which have to do with the internal functioning of the body. Striated or skeletal muscle has to do with the adjustment of the individual to his surroundings and is connected with the nervous system which controls it. In this study we are concerned only with

---

1. G. L. Freeman, Introduction to Physiological Psychology, New York, The Ronald Press Company, 1934, p. 246.





skeletal muscle.<sup>1</sup>

Properties of muscle fibers. Striated or skeletal muscle fiber possesses the property of contractility. This occurs when a motor nerve impulse shortens the fibers lengthwise. Skeletal muscles of the body are not all of one color. There are two kinds of muscle fiber; red and white. This is due to the fact that the muscles in the different positions on the skeleton have different duties to perform. The red muscle fibers are red due to the presence of muscle hemoglobin and contain large amounts of stored fat which enables them to sustain long activity. The second type of fiber is white because it functions for brief periods of time only, contracts more readily and relaxes more readily than the red fibers. Thus we find that the extensors, which hold the animal erect or in "sustained activities", are necessarily red fibers--and the flexors, which make "quick, temporary adjustments", are white fibers. "The point, briefly, is that effectors are of two kinds: phasic, for the quickly executed; and postural, for the sustained, more permanent behavior."<sup>2</sup>

Muscles and the skeletal musculature. A muscle consists

- 
1. C. T. Morgan, Physiological Psychology, New York and London, McGraw-Hill Book Company, Inc., 1943, p.308.
  2. C. T. Morgan, op. cit., p.310.



Myeloid muscle.

Properties of muscle fibers. Stained or striated muscle

fibers possess the property of contractility. This occurs when a motor nerve impulse reaches the fiber. In fact, the skeletal

muscles of the body are all of this type. There are two

kinds of muscle fibers, red and white. This is due to the fact

that the muscles in the different positions on the skeleton

have different duties to perform. The red muscle fibers are

red due to the presence of muscle hemoglobin, and contain large

amounts of stored fat which enables them to sustain long periods

of activity. The second type of fiber is white because it is well

supplied with blood vessels, contains more readily and is

less able to store fat. This is the fiber that is

responsible for the rapid movements of the body. It is

also the fiber that is responsible for the rapid movements of the

body. The white muscle fibers are also the fibers that are

responsible for the rapid movements of the body. The white

muscle fibers are also the fibers that are responsible for the

rapid movements of the body. The white muscle fibers are also

muscles and the skeletal system. A muscle consists

of many muscle fibers. The fibers are held together by a

connective tissue called the sarcolemma.

The sarcolemma is a thin layer of

of a group of muscle fibers covered by connective sheaths which is attached to bones by tendons or to other muscles. As has been pointed out, there are flexors (which lift the limb for motion) and extensors (which provide support). Another characteristic of skeletal muscles, therefore, is their combination into groups. In coordinating movement, a muscle may:

1. Act as agonist or prime mover of the limb.
2. Act as antagonist--opposing agonist and thus enabling smooth limb movement.
3. Act synergically, thus cooperating with the agonist. e. g. wrist muscles cooperate with the fingers.
4. Act as fixator. e.g. hold a large part steady, such as the hand, while the fine muscles act, as in threading a needle.

1

## THE NEUROMUSCULAR SYSTEM

The motor unit. The efferent or ventral horns of the spinal cord are responsible for the functioning of skeletal musculature. Leaving the cord are the nerves which divide into axons and finally into febrils. These febrils are attached to and innervate the muscle fibers. A study by Weirsm<sup>2</sup> demonstrates that each muscle fiber receives only one febrile. We can see, therefore, how many fibers may be controlled by one motor neurone.

The functional significance of this fact is important in

1. G. L. Freeman, Introduction to Physiological Psychology, New York, The Ronald Press Company, 1934, p. 120.
2. C. T. Morgan, op. cit., p. 309.





the present study. Morgan<sup>1</sup> tells us, "The size of a motor unit varies from place to place in the body. In some muscles the innervation ratio of motor neurons to muscle fibers is as high as 1:150, whereas in others, the ratio may be as low as 1:3." The innervation ratio is high, therefore, for the large muscles and low for the small muscles. It is well to bear this point in mind in this study, which is concerned with a disease which is caused by damage of anterior horn cells in the spinal cord.

The simple reflex. A reflex whether simple or complicated consists of the following five steps: (1) Receptor stimulation; (2) nerve conduction toward a center; (3) impulse adjustment at the center or centers; (4) motor impulse conduction to the effector; (5) effector activity response.

Reciprocal Innervation. For the efficient pursual of our study, it is necessary for us to refer to reciprocal innervation, which is one of the properties of the nervous system. Reciprocal innervation or inhibition plays a most important role in the activity of the nervous system.<sup>2</sup> We may even say that coordination is brought about by the blending of excitation and reciprocal innervation. "Through it, the contraction of one muscle, a flexor, for example, is accompanied by relaxation of its antagonist, the extensor."<sup>3</sup>

---

1. C. T. Morgan, op. cit., p. 309.

2. C. S. Sherrington, Integration of the Nervous System, New Haven, Yale University Press, 1906.

3. C. T. Morgan, op. cit., p. 311.





Thus, having established the primary goal of physiological psychology--the physiological mechanism of normal human and animal behavior--let us examine the pathology of the disease, poliomyelitis.

### PHYSIOLOGIC ANATOMY OF POLIOMYELITIS

When the virus of poliomyelitis attacks the ventral horn cells of the spinal cord, the muscle fibers innervated by that cell degenerate and may disappear entirely. Eccles and Sherrington<sup>1</sup> introduced the term "motor unit", for as has been stated, one ventral horn cell innervates groups of skeletal muscle fibers. That the degeneration of nerve fibers in poliomyelitis and amyotrophic lateral sclerosis follows a like pattern<sup>2</sup> was observed by Wohlfart. He states that discrete muscle fasciculi are effected rather than muscle fibers, and shows, by sections of atrophic poliomyelitis muscles, that although there may be atrophy of all striated muscle fibers in one fasciculus, the next fasciculus may appear normal. Because the unit rather than the individual fiber degenerates, therapeutic measures and practices recommended for the treatment of poliomyelitis should be based on these considerations.

Not so long ago, the treatment of early cases of poliomyelitis was standard--complete immobilization of the affected muscles. Now, the Kenny treatment advocates free movement and

1. J. C. Eccles, and C. S. Sherrington, "Numbers and Contraction Values of Individual Motor Units Examined in Some Muscles of the Limb," Proceedings Royal Society, Series B, London, 106: 326, June 2, 1930.
2. G. Wohlfart, and R. L. Swank, "Pathology of Amyotrophic Lateral Sclerosis: Fiber Analysis of the Ventral Horn Roots and Pyramidal Tracts of the Spinal Cord," Archives Neurology and Psychiatry, 46: 783, November, 1941.





passive movements of the affected muscles. Because normal units become atrophied under conditions of immobilization, freedom of movement appears indicated if all available motor units of paralyzed muscles are to retain their maximum physiologic capacity. Although we have no experimental evidence to support the contention that appropriate manipulation can encourage the functioning of muscle fibers which have atrophied due to degeneration of the anterior horn cells, we do know that muscle fibers are dependent on their local reflexes for normal stimulation. The flow of proprioceptive impulses is arrested by immobilization.

Regardless of whether the reader will agree with the writer regarding the importance of discarding immobilization, he will agree that it is clearly essential to interpret correctly and understand thoroughly the pathologic condition of the disease, poliomyelitis, before evaluating effective treatment. The prognosis depends upon the severity and distribution of the disease and the efficient treatment of the remaining capacities.

The damage resulting from the attack on the ventral horn cells of the cord by the virus, poliomyelitis, is due to:<sup>1</sup> (1) direct pressure on the nerves, to hemotoma, exudate, and edema; (2) anemia due to constriction of the blood vessels; (3) direct toxic action of the virus itself on the nerve cells. If nature absorbs the toxic products soon enough and the nerve cells have not degenerated on account of the anemia and pressure, the cells

1. M. McMillan, Massage and Therapeutic Exercise, Philadelphia, W. B. Saunders Company, Third Edition, 1932, p. 135.





recover their function. Here the prognosis is good. However, if these toxic products produce prolonged unfavorable conditions, the nerve cells may completely degenerate. Here the prognosis is poor. It is essential, therefore, to keep the body in proper condition by preserving all potential neuromuscular units. A paralyzed muscle fiber will not contract until its physiologic processes have been restored, and its physiologic processes cannot be completely restored if there has been a break in the anatomic continuity<sup>1</sup>. Therefore, one must bear in mind that although an anatomic unit may be intact, it may not be able to function physiologically immediately after the acute phase of the disease.

After the acute attack of the virus on the anterior horn cells, scar tissue, which cannot transmit or generate nerve impulses, forms. The axon and nerve fibers disappear and the muscle fibers which were innervated therefrom undergo fatty degeneration and fibrosis. No treatment can help this class of patient. However, the patient who does obtain an increase in muscle power during convalescence owes this to:

1. Compensatory increased functional activity of the muscle tissue innervated by normal nerve cells which were not affected by the virus.
2. Return of the physiologic function of the neuromuscular units of which the nerve cells were only temporarily affected.

---

1. H. E. Ripps, "Muscle Pathology in Anterior Poliomyelitis; Its Relation to Function," Southern Medical Journal, 34: 135, February, 1941.





## CHAPTER IV

### THE ORTHODOX TREATMENT OF ANTERIOR POLIOMYELITIS

#### THE "ACCEPTED" CONCEPT OF THE DISEASE

According to the orthodox theory, the disease and its treatment of the disease, poliomyelitis, is divided into three stages, acute, convalescent, and chronic.

#### PART TWO

### THE ORTHODOX METHOD OF THE TREATMENT

#### OF ANTERIOR POLIOMYELITIS

Therefore, in a state of normal health, the patient is directed to the hospital clinic where he will be treated.

The risk of the early and subsequent stages of poliomyelitis is, therefore, to be avoided. The "accepted" method of treatment of the first stage is immobilization of the patient in bed, with the limbs in a state of rest, and the use of a cast or plaster. It is believed that the patient should be kept in bed until the acute stage has passed, and then the patient should be allowed to get up and walk. The patient should be kept in bed until the acute stage has passed, and then the patient should be allowed to get up and walk. The patient should be kept in bed until the acute stage has passed, and then the patient should be allowed to get up and walk.

It may be stated that if there is a possibility of the patient being held in a state of rest, the patient should be kept in bed until the acute stage has passed, and then the patient should be allowed to get up and walk.





## CHAPTER IV

THE ORTHODOX TREATMENT OF ANTERIOR POLIOMYELITISTHE "ACCEPTED" ORTHODOX THEORY

According to the orthodox theory, the course and treatment of the disease, poliomyelitis, is divided into three stages: acute, convalescent, and chronic. The damaged muscles are the flaccid muscles, the opponents or well muscles being normal--therefore, in a state of normal tonus. All attention is directed to the flaccid muscle which cannot contract.

The task of the acute and convalescent period of poliomyelitis is, therefore, to preserve these "flaccid muscles". The chief principle of the treatment is immobilization by means of frames, splints, plaster casts, etc. To protect a weak muscle, it is believed that the origin and insertion of that muscle should be brought closer together than in a neutral position and that the stronger muscle (opponent) should be put slightly at a disadvantage. A muscle which is being kept shortened in a splint should be protected from strain and stretch.

By way of illustration: if there is a foot drop, the foot being held in plantar flexion, the orthodox school considers the anterior group of the lower leg paralyzed and the posterior





group normal but pulling because of the "lack" of pull from the flaccid anterior group. After the sensitive period is passed, therefore, and a program of muscle re-education is started, all attention is directed toward the re-awakening of this anterior group.

#### PHYSICAL THERAPY TREATMENT

Heat. The orthodox method considers some form of external heat, which is applied during the first part of the physical therapy treatment, beneficial. This may be applied in different ways such as radiant heat from a hood baker or deep therapy lamp, or non-luminous heat from an infra red lamp. Legg and Merrill<sup>1</sup> believe that there is no advantage to be gained by the use of medical diathermy. At home, hot blankets are recommended.

Massage. Massage is recommended because it increases the blood supply, keeps up the nutrition to the part, and acts as a form of passive exercise. The technique is important, however; the muscle should be raised from the bone (gentle petrissage) rather than flattened down on it (effleurage).

Muscle training. By muscle training, the orthodox system means "the localized action of certain definite muscles or muscle groups--the attempt to exercise and develop certain

---

1. A. T. Legg, and J. B. Merrill, Physical Therapy in Polio-myelitis, Principles and Practices of Physical Therapy, Hagerstown, Maryland, Prior Co., 1942, p. 40.





muscles, without at the same time bringing into play other muscles whose action is, for some reason undesirable."<sup>1</sup> An effort should be made to carry out the full arc of motion. Passive motion is considered useless and is never carried out. Attempted voluntary movement is recommended until active movement is possible.

Again, by way of illustration, let us consider the previously stated example of the dropped foot: Since the anterior group muscles of the lower leg are flaccid, muscle training would be directed to make the patient actively dorsi-flex the foot. No attention is paid to the posterior group (for they are considered normal); the patient is not even allowed to plantar flex the foot during the muscle training period, for the physical therapist passively takes the foot into plantar flexion and requests the patient to dorsi-flex actively or assistive-actively.

The first step to muscle training is, therefore, an examination to determine the amount of power which exists in the different muscles or muscle groups. The grade recorded for the tested muscle is based upon its strength which is determined by its functional ability. Then, after the relative functional strength of the various muscles and muscle groups is recorded, the physiotherapist decides what exercises are best suited for the individual case. The exercise position must be suited to the power present in the affected muscle so that the patient will not be asked to perform an exercise which is too difficult for the paralyzed or flaccid muscle. The testing position is

---

1. A. T. Legg and J. B. Merrill, op. cit., p. 41.





used for giving the exercise, for the former determine the latter. There are three ways of giving a voluntary or active exercise:

1. Against resistance.
2. Free or unaided.
3. With assistance.

The three types of exercise are:

1. With the aid of gravity.
2. With gravity neutralized or eliminated.
3. Against gravity.

#### MUSCLE TESTING

It is not difficult to see the importance of having an accurate measure of testing an educational procedure. How else, then, can we determine the value of a procedure or evaluate progress? However, a critical analysis of the muscle test of today uncovers many shortcomings.

In 1915, Dr. Lovett and his assistant, Wilhelmina Wright, felt the need of some sort of a measure in the treatment of Infantile Paralysis. Dr. E. A. Sharpe of Buffalo had developed a system which was in use at that time. This system of grading consisted of anterior and posterior charts of the body. The examiner would shade in the muscles according to their tested strength: paralyzed muscles were closely shaded, partially paralyzed muscles were shaded with coarse lines, and normal muscles were not shaded at all. Although these charts gave "the picture at a glance", this system was lacking in detail.





Dr. Lovett then went to work with E. G. Martin of the Physiological Department of the Harvard Medical School to develop an improved test. They originated the "Spring Balance Muscle Test", which measured loss and gain in muscle strength in pounds. This test was also found lacking, for it measured fairly strong and strong muscle groups efficiently, but failed to measure the weak muscles of infantile paralysis victims. At that time, there were many articles and books which described<sup>1</sup> this test.

It was then that Dr. Lovett originated a system which graded muscle strength in relation to gravity. This method was enthusiastically received by physicians and physical therapists throughout the country, and it now serves as the basis of muscle testing in most clinics and hospitals. "The method of examination described is not a mathematically accurate one, but it has the advantage of requiring no apparatus and of providing a graded series of tests for estimating muscular power.

- 
1. R. G. Lovett, and E. G. Martin, "Certain Aspects in Infantile Paralysis with a Description of a Method of Muscle Testing," Journal of American Medical Association, 66: No. 10, 1916, 729-733.  
 Lovett and Martin, "The Muscle Test for Infantile Paralysis, A Description of the Technique," American Journal Orthopedic Surgery, July, 1916.  
 R. W. Lovett, The Treatment of Infantile Paralysis, Philadelphia, P. Blakeston and Company, Second Edition, 1917.







The muscles are graded as:

- Gone -- no contraction felt; totally paralyzed.
- Trace -- muscle can be felt to tighten, but cannot produce movement.
- Poor -- produces movement with gravity eliminated, but cannot function against gravity.
- Fair -- can raise the part against gravity.
- Good -- can raise part against outside resistance as well as against gravity.
- Normal-- can overcome a greater amount of resistance than a 'good' muscle."

1

Although this method of testing is the most popular and reliable to date, an investigation reveals many weaknesses. Unfortunately, there is no standardized interpretation of the grades. <sup>2</sup> Lowman, for example, uses 10 grades--"0-9". The Kendalls <sup>3</sup> use 14 grades --"0-Normal plus". The latter also suggest muscle strength percentages be recorded to correspond with the above grades. (See Table on next page) A "fair plus" to Lowman means "beginning action of joints but not against gravity or enough to overcome friction of the table". A "fair plus" to the Kendalls means "completes the arc of motion against gravity and a minimum amount of resistance". This status of muscle testing is regrettable in the transfer of patients from one institution to another, and is confusing to

- 
1. R. W. Lovett, Treatment of Infantile Paralysis.
  2. G. L. Lowman, Technique of Underwater Gymnastics, American Publications Inc., Los Angeles, California.
  3. Henry O. Kendall and Florence P. Kendall, "Care During Recovery Period of Paralytic Poliomyelitis," Public Health Bulletin, No. 242, United States Government Printing Office, Washington, D. C., 1939.







TABLE I  
THE KENDALL SYSTEM OF MUSCLE GRADING\*

<u>Percentage</u>	<u>Equivalent Of</u>	<u>Test</u>
0	zero	No contraction felt in muscle
5	trace (tr.)	In a 5% muscle, contraction is felt but there is no apparent movement of the part.
10	poor minus (P-)	A 20% muscle moves the part through a partial arc of motion with gravity eliminated.
20	poor (P)	
30	poor plus (P+)	
40	fair minus (F-)	A 50% muscle completes the whole arc of motion against gravity but may tire after two to three movements.
50	fair (F)	
60	fair plus (F+)	A 60% muscle completes the arc of motion against gravity and a minimum amount of resistance.
70	good minus (G-)	
80	good (G)	An 80% muscle completes the arc of motion against gravity and a medium amount of resistance several times without showing signs of fatigue but tires quickly or is unable to complete the arc of motion against a maximum amount of resistance.
90	good plus (G+)	
95	normal minus (N-)	A 100% muscle completes the arc of motion against gravity and a maximum amount of resistance several times without showing signs of fatigue.
100	normal (N)	
Contracted	normal plus (N+)	

---

\* The Kendalls emphasize the neutral or ideal rest position for protection of the entire body. Such protection includes prevention of stretching or strain of weakened muscles and is accompanied by protective supports, special handling during nursing and physiotherapy. They also advocate restriction of joint motion with assistive movements prohibited through the whole functional arc until the muscle is able to return actively to its shortened (orthodox) position. The Kendalls also advocate the use of heat, massage, and pressure suction treatment to prevent atrophy of the affected muscles. Nansson of New York believes that the long period of inactivity which the Kendalls' system imposes is inevitably accompanied by psychologic injury.





## BOSTON CITY HOSPITAL

48-  
-57-

TABLE II

## Muscle Test

No.

DATE

## PATIENT'S NAME

Cannot walk, walks unaided, with braces, crutches and corset.

## CHARACTERISTIC GAIT

## SCOLIOSIS

LEFT LEG

Contractions and Deformities

RIGHT LEG

Hip

Knee

Ankle

Orbit

Facial

Mouth

Anterior Neck

Posterior Neck

Back

Respiration

Quadratus Lumborum

Anterior Abdominals

Lateral Abdominals

Gluteus Maximus

Hip Flexors

Sartorius

Inward Rotation

Outward Rotation

Tensor Fasciae Latae

Hip Abductors

Hip Adductors

Quadriceps

Inner Hamstrings

Outer Hamstrings

Gastrocnemius

Anterior Tibial

Posterior Tibial

Peroneals

Extensor Longus Digitorum

Extensor Proprius Hallucis

Flexor Longus Digitorum

Short Toe Flexors

Flexor Longus Hallucis

Length

Thigh

Calf



## LEFT ARM

## Contractions and Deformities

## RIGHT ARM

Shoulder

Elbow

Wrist

Fingers

Anterior Deltoid

Posterior Deltoid

Upper Trapezius

Middle Trapezius

Lower Trapezius

Serratus Magnus

Rhomboids

Latissimus Dorsi

Clav. Pect. Major

Stern. Pect. Major

Outward Rotators

Biceps

Triceps

Supin. Brev.

Pronators

Flexor Carpi Rad.

Flexor Carpi Uln.

Extensor Carpi Rad.

Extensor Carpi Uln.

Flex. Prof. Digit.

Flex. Sub. Digit.

Finger Ext.

Lumbricales

Dors. Inteross.

Palm. Inteross.

Oppon. Poll.

Abd. Poll.

Thumb Flex.

Thumb Ext.

---

Upper Arm

Lower Arm

students as well as to physicians and physiotherapists who desire to evaluate progress of these patients. The need for an immediate muscle test on admittance is obvious. Although there is an attempt made here for objectivity, the judgment of the examiner is brought into play. Most examiners add plus or minus to grade more accurately; the factor of fatigue of the patient comes into play; the resistance given by the examiner may not always be the same; there may be a change in the weight of the patient's limb; and there is the possibility that the same position may not be assumed every time a repeat test is given.

The muscle chart most commonly used is made up of individually listed muscles. (See Table II) Although there may be slight variations in the presentation of muscles on the charts in the various institutions throughout the country, testing is based on the premise that it is possible to test individual muscle strength. Recently, Signe Brunnstrom<sup>1</sup> attacked this premise and attempted to improve the validity and reliability of muscle testing by advocating muscle group testing, but there are many who do not approve of this method for various reasons. As Miss Brunnstrom points out, an investigation makes one question the possibility of testing one muscle alone without bringing into play other accessory muscles. No matter how simple the movement, there is usually more than one muscle brought into

---

1. S. Brunnstrom, "Muscle Group Testing", The Physiotherapy Review, Vol. 21, January, February, 1941.





play. Besides, movements and not individual muscles are represented in the cerebral cortex.<sup>1</sup>

Electrical Testing and Stimulation. There are definite physiological reasons why electrical stimulation of muscles may be useful in the treatment of infantile paralysis. Dr. Lovett<sup>2</sup> wrote, "The well being and efficacy of a muscle is largely dependent on the performance by it of a certain number of active contractions. When a muscle is inactive for any length of time, it atrophies. It is an accepted physiological principle that the exercise of the normal functions of a muscle is the best means of increasing its size and strength. The same rule applies to the partially paralyzed muscle." It is a well known fact that muscles which do not function become atrophied, lose their property of contractility, and eventually become connective-<sup>3</sup> type tissue. Tilney wrote, "It remains for us to supply the deficient function of contraction by whatever means we possess. Electricity is one of these means. If the muscle is not fully paralyzed, but only weak, the causing of contractions, not only prevents the atrophy of the paralyzed muscles, but also exercises and strengthens the non-paralyzed part and thus enables it to do compensating work."

Since we have already established the fact that nerve

1. C. W. Beevor, The Croonian Lectures on Muscular Movements and Their Representation in the Nervous System, London, Adlard and Son, 1904.
2. Lovett, Treatment of Infantile Paralysis, pp. 25, 73-76.
3. F. Tilney, "The Present Management of the Poliomyelitis Epidemic in New York City," New York Medical Journal, 104: 1221, Dec. 23, 1916.





fiber has the property of conducting electricity, it is reasonable to assume that by stimulating the motor point of the nerve (point where the nerve pierces the muscle) we should cause a contraction of that muscle.

The galvanic and faradic test is used for the purpose of testing paralyzed or weak muscles in order to obtain a "picture" of the anatomic condition of these muscles.<sup>1</sup> In radicular and peripheral nerve injuries, an electrical examination usually reveals a group affection of adjacent muscle groups. In poliomyelitis, there is an uneven participation of muscles of the same radicular group.<sup>2</sup> For example, the gastrocnemius may be affected and none of the same group. Frequently, there is only a partial reaction of degeneration although there is marked degeneration and atrophy present. That is, the nerve responds to faradism because certain levels of the spine were not affected and some of the nerve fibers are still alive and able to conduct to the live portion of the muscle. Because the development of the R. D. (reaction of degeneration) in poliomyelitis is quite slow, taking from 10-14 days, electrical tests should be taken at frequent intervals. The test is done by comparison of the reaction to the electrical currents of two like extremities. Of course, this is not possible in some cases where both extremities are affected. Although a chart may thus be made of qualitative findings, these figures are not helpful for future comparison.

1. R. Kovacs, Electrotherapy and Light Therapy, Second Edition, Philadelphia, Lea and Febiger, 1935, p. 175.
2. R. Kovacs, "Electrotherapy in Infantile Paralysis," International Bulletin for Economics, Medical Research, and Public Health, Vol. A. 40, 1939.





Other methods of qualitative measurement are chronaximetry and the condensor method of testing. These tests are more valuable for they enable the examiner to record response in figures. Thus progress may be charted and followed. Besides, these tests are less painful than those by the galvanic and faradic currents. Of course, when a muscle is less sluggish and responds to less current, the prognosis improves.

Hansson, Troedsson, and Schwarzkopf (Cornell University)<sup>1</sup> carried on some electromyograph studies in poliomyelitis. Poliomyelitis patients were tested with electromyography and the Lovett muscle test. They came to the conclusion that because of its extreme sensitivity, the electromyograph is an efficient test, not only to check the progress and regress of the condition, but also to measure the amount of cord damage.

While it may appear that electricity furnishes the answer to the need of a valid and reliable test for the efficient treatment of infantile paralysis, it must be conceded that there are many draw-backs. As has already been stated, the electrical procedure is far from pleasant. Since children are usually the victims of the disease, it is easy to see why electrical testing and stimulation is used so infrequently. In giving tests for R. D., in peripheral nerve injuries in adults, it is difficult to influence the patient to cooperate in taking electrical stimulation. Much patience, on the part of both patient and examiner, is required. How much more difficult it

---

1. K. G. Hansson, B. S. Troedsson, and E. Schwartzkopf, "Electromyographic Studies in Poliomyelitis," Archives Physical Therapy, 23: 261-266, May, 1942.





would be to test a child with poliomyelitis where the paralysis is scattered throughout the body and there is no normal corresponding extremity with which to make comparison. Furthermore, electrical muscle testing necessitates a technical knowledge of motor point distribution and much experience with which to evaluate results. It may also be stated that many physicians frown upon treatment by electrical means either because of prejudice or lack of knowledge thereof.





## CHAPTER V

### THE KENNY METHOD OF TREATMENT OF

#### ANTERIOR POLIOMYELITIS

#### THE KENNY METHOD

The fundamental idea of the Kenny treatment is a gradual building up of muscle re-education. While the subject of the

#### PART THREE

muscle re-education is gradually built up, without any

muscle re-education. The Kenny Method of Treatment of

Anterior Poliomyelitis. The belief

that the primary effect of the disease is to destroy the

muscle fibers of the anterior horn of the spinal cord

and that the primary effect of the disease is to destroy the

muscle fibers of the anterior horn of the spinal cord

and that the primary effect of the disease is to destroy the

muscle fibers of the anterior horn of the spinal cord

1. Although the lesion may be in a single spinal cord segment, the entire spinal cord should be treated. If the lesion is not treated, the muscle fibers of the spinal cord will be destroyed, and the treatment will be ineffective.

2. Since a remedy is available for the treatment of the disease, the treatment should be continued until the disease is completely cured.

3. A patient who has been treated for the disease should be kept in bed for a period of at least six weeks after the treatment is completed. During this period, the patient should be kept in bed and should not be allowed to get up.





CHAPTER V  
THE KENNY METHOD OF TREATMENT OF  
ANTERIOR POLIOMYELITIS

THE KENNY CONCEPT

The fundamental idea of the Kenny treatment is a greatly detailed system of muscle reeducation. While the concept of the orthodox system was flaccid paralysis, without spasm and in-coordination, Miss Kenny's cardinal principles are; pain, muscle spasm, mental alienation, and muscle incoordination. She believes that the primarily affected muscles are in spasm and that the muscles we formerly considered flaccid are on a stretch due to this spasm of the primarily affected group. She believes, therefore, that she is able to avoid much permanent paralysis by relieving this spasm. This muscle spasm may cause weakness or paralysis in four ways:

1. Although the lesion may weaken a muscle, the spasm should be treated. If the spasm is not treated, the muscle fibers may be completely damaged, contractures result, and no treatment can later be effective.
2. Disuse atrophy or paralysis may result in the over-stretched group of muscles because of the spasm of the affected group.
3. A subconscious mental alienation may result due to the pain from attempts to move spastic muscles. Even after muscle spasm has gone, patient may not be able to consciously activate muscle. Muscle reeducation should establish mental awareness.

1. E. Kenny, The Treatment of Infantile Paralysis in the Acute Stage, Minneapolis, Bruce Publishing Co., 1941, p. 9.







4. A pseudoparalysis may result because of the mechanical disadvantage of the opposing muscles which this strong spasm may bring about.

Mental alienation is an interruption of mental pathways which separates a muscle from voluntary action because of pain, fear of pain, or of an interruption of conduction pathways by the disease. It may be avoided if spasm and pain are relieved quickly enough and muscle reeducation begun as early as possible.

Mental incoordination is the result of substitution of other groups of muscles because of diverted mental pathways due to attempts to activate involved muscles. In order to avoid this, strict supervision and proper training should prevent use of weakened or painful muscles.

The principles of the Kenny treatment are strictly<sup>1</sup> against any use of immobilization. The aims are:

1. To start treatment immediately upon diagnosis.
2. To maintain good nursing care for the health and vitality of all unaffected as well as affected parts of the body.
3. To prevent complications and undesirable sequelae
4. To reestablish normal conduction pathways of affected parts.
5. To avoid any procedures which would interfere with these goals.

These concepts "loss of mental awareness" and "mental alienation" have been the subject of much controversy and are not accepted by some observers. Their chief disadvantage lies in the fact that the terms do not have the validity that goes with common medical usage. It is our purpose to investigate

---

1. E. Kenny, op. cit., p. 11.





these terms at this time.

Splinting. "Splinting for the purpose of immobilization does not constitute any part of the treatment....It would prevent the treatment of the muscles and would tend to increase the undesirable and damaging condition of spasm in the hyper-<sup>1</sup>irritable muscle tissue." Obviously, where there is splinting, there is bound to be poor circulation and trophic changes resulting in stiffness. In Chapter III, we established the characteristics of the proprioceptive system of the body. We found that physiological psychology has established the fact that the adequate stimuli of the kinesthetic receptors are the tensions and contractions of muscles and tendons, and pressure and friction on the joint surfaces. When the normal functions of the body are restricted by immobilization, the peripheral receptors cannot transmit impulses for the stimulation of the proprioceptive nerve endings. "Physical dissociation of the limbs from the body is suggested in the patient's mind by splinting. Mental alienation, incoordination, and loss of function<sup>2</sup> follow."

In summary, Kenny condemns splinting for the following reasons:

1. "It prevents treatment of the disease--that is, symptoms of the disease in the early stages.

---

1. Pohl and Kenny, op. cit., p. 94.

2. Pohl and Kenny, op. cit., p. 288.





2. It prolongs the condition of muscle spasm and prevents its treatment.
3. It prevents treatment for the restoration of coordination of muscle action--a serious error.
4. It promotes the condition of stiffness, which prevents satisfactory treatment either for the symptoms that brought about the muscle spasm, or the development of muscle power by reeducation or the reawakening of the impulse.
5. It interferes with the nutrition of the skin, subcutaneous tissue, and muscles.
6. It reduces the circulation.
7. In any system of treatment it cannot prevent deformities. If introduced in the Kenny Treatment, it would not allow treatment. In the orthodox treatment, it does not prevent deformities of which there is unfortunately abundant evidence.
8. It diminishes the volume of nerve impulses through the nervous system along the afferent and efferent paths.
9. It produces changes in the capsular ligaments and prevents their normal functioning.
10. It interferes with the normal function of subconscious mind.
11. The synovial fluid tends to disappear and the joint to become dry.
12. It gives the patient an adverse psychological outlook.<sup>1</sup>

" In the Kenny system, the goal is coordinated balanced function which is obtained by reestablishment of nerve pathways and mental processes, and minor importance is assigned to strength."<sup>2</sup>

1. E. Kenny, Infantile Paralysis in the Acute Stage, Minneapolis, Minn., The Bruce Publishing Co., 1941, p. 21.
2. E. Kenny, op. cit., p. 11.





Sister Kenny's belief in the importance of getting away from the ritual of complete immobilization may sound revolutionary at first sight, but there was actually a time when the treatment of fractures was characterized by a long period of immobilization also. The results were muscle atrophy and stiff, ankylosed joints. Now, immobilization of fractures is not so lengthy and motion of proximal joints begun as early as possible. Function return is 100% improved.

1

Ober, of Boston, writes that a long period of immobilization which is supposed to prevent deformities and relieve pain does not attain its aims, for joint stiffness and atrophy occur. He claims that, without doubt, the Kenny treatment relieves muscle soreness earlier and that the general condition of the patient is good, with a more healthy skin and less localized atrophy.

### PAIN

Miss Kenny believes that "muscle spasm is a constant accompaniment of the muscle pain and that it may be the real and sole cause of pain." <sup>2</sup> In her opinion, this pain is primarily due to an ischemia. Any factors which cause ischemia, increased tone, or increased excitability in the muscles aggravate the spastic condition through the skin reflexes. By attempting

- 
1. F. R. Ober, "Early Management of Poliomyelitis and the Kenny Treatment," Conn. State Medical Journal, 7: 16-18, Jan. 1943.
  2. E. Kenny, op. cit., p. 9.





to control this pain, hypertonicity is increased, for the patient is too frightened to move and holds himself rigid in bed. Since pain is the common symptom of all stages in the disease, the patient is in constant fear of its occurrence; thus, he immobilizes himself.

<sup>1</sup>  
Darwin writes, "In the agony of pain, almost every muscle of the body is brought into strong action, for great pain urges all animals, and has urged them during endless generations, to make the most violent and diversified efforts to escape from the cause of suffering."

It is also a fact that pain may have a depressive effect at times. <sup>2</sup> Martin and Lacey have demonstrated that a fall of blood pressure may be caused by any stimulus that induces pain. It seems logical to assume, therefore, that the pain stimulus to the affected muscle makes it go into spasm. This spasm may be responsible for the ischemia or it may be the fault of the blood pressure mechanism to get a fresh blood supply to the <sup>3</sup> muscle. Perhaps both factors play a role here.

On investigation, we find this condition might rightly lead to paralysis, whether temporary or permanent. We have already established the fact that the "circulatory system is an integrator." It brings nutrition to the part and carries away waste products. We have also established the fact that

- 
1. C. R. Darwin, Expression of Emotions in Man and Animals, New York, D. Appleton, 1905, pp. 101-117.
  2. E. G. Martin and W. H. Lacey, "Vasomotor Reflexes from Threshold Stimulation", American Journal of Physiology, XXXIII, p. 212, 1914.
  3. W. B. Cannon, Bodily Changes in Pain, Hunger, Fear, and Rage, New York, D. Appleton, 1929, pp. 197-198.





if a nerve is confined in an atmosphere free from oxygen (which would be the case in a muscle in spasm), the nerve loses its excitability. Furthermore, the circulation being impaired, the temperature in which the nerve finds itself is important, for "cooling a nerve alters its rate of conductivity". Last, but not least, it should be remembered that pain may cause a "conditioning" (condition reflex) which leads to the pseudoparalysis<sup>1</sup> which Sister Kenny calls "mental alienation". Pohl stresses the importance of protecting the patient from fear. Muscles that are not functioning may remain in that state permanently unless treated. An example of "mental alienation" not due to infantile paralysis which is frequently seen by orthopedic surgeons and physical therapists is the inability of some patients to contract the quadriceps after a knee operation or other painful lesion of the joint. Often reeducation for a prolonged period of time is needed before these cases obtain normal control of the muscle.

#### MUSCLE SPASM

The physical condition of skeletal muscle in spasm is characterized by tenderness, tenseness, prominence, tautness, and pain. Miss Kenny states that the term "spasm" is used when there is a series of contractions felt in the part. "A contraction is a condition of unrelaxed shortening, which if taken

---

1. Pohl and Kenny, op. cit.





in time, can be relaxed passively; it is without exaggerated tonus and may relax during a sleep. A spasm, however, will not relax while patient is asleep."<sup>1</sup>

The Argument. Sister Kenny claims to have proved that the painful muscles are the muscles in spasm and are the ones primarily affected by the disease. The shortening of this spasm causes them to become hard, inelastic masses. Eventually, they may paralyze their opponents because of disuse even if the latter are not also shortened by the state of spasm. Therefore, the spasm in the acute stage of poliomyelitis is the cause of loss of power in muscles and the majority of deformities. The opposing muscles, being stretched beyond normal relaxation, cannot contract, for the spastic muscles cannot relax enough to take up the slack. She also claims that muscle stiffness or shortening due to spasm may be detected from the onset of the disease in 100% of cases. She believes that spasm is the prelude of paralysis, that spasticity is the predecessor of flaccidity, and that unrelaxed muscle contractions due to unrelieved spasm leads to joint stiffness. From the onset of the disease, therefore, muscular contraction or muscle spasm may set in in both affected and unaffected groups. Both synergists and antagonists may thus be affected due to the following causes:

---

1. E. Kenny, op. cit., p.91.





1. Patient's effort to control pain by immobilizing himself.
2. Patient's effort of voluntary movement.
3. Reflex activity.

According to Miss Kenny, spasm is produced by:

1. Ischemia--circulatory changes.
2. Cord lesion irritation.
3. Toxic or inflammatory changes.
4. An accumulation of excessive acetylcholine.

The spasm may thus produce an anoxia which leads to contractures and fibrosis. In this way, Miss Kenny says, the spasm itself may cause pathologic changes, even without any pathology of motor nerve cells.

In order to acquaint the reader with the great importance which Miss Kenny places on muscle spasm, I call his attention to the fact that Miss Kenny separates the disease into two stages: the acute stage, while spasm and pain are present; the convalescent stage, after spasm and pain are relieved. Since the Kenny treatment is the "treatment in the acute stage of the disease", all attention is immediately directed toward eliminating the spasm. Since Miss Kenny does not approve of too frequent examination in the acute stage, she advises that the diagnosis of spasm be made only by observation of muscle or tendon prominence, abnormal skin creases, and characteristic positions taken by the part.

By way of illustration and comparison, let us consider





again the example of the "dropped foot." Miss Kenny claims that a foot drop is not caused through the paralysis of the anterior group--as the reader will recall is the belief of the orthodox system--but by a spasm in the posterior group. The muscle spasm produces a brake by the shortening of one muscle, which prevents its overstretched opponents from contracting physiologically and thereby becoming alienated. In summary, therefore, we may say that the basic symptom of infantile paralysis according to the Kenny Concept is muscle spasm, an involuntary and uncontrollable shortening of muscle fibers, not to be confused with "spasticity" of an upper motor neuron, which will relax under steady tension. Can the reader now understand why the Kenny Concept landed like a "bomb shell" and caused, and is still causing, so much controversy?

Let us investigate this "spasm." Is there really spasm in a disease we formerly thought of as a flaccid paralysis disease? Since it is impossible to illustrate its presence here clinically, what do we find in the literature?

<sup>1</sup>  
Haggqvist, in an article in the International Bulletin, places great importance to Miss Kenny's theory. He states that many research workers have described cases of acute poliomyelitis which presented the symptom of spasm. He cites:

Strumpell	1885	Neurath	1901
Medin	1896	Marie	1902
Pasteur	1897	Hoffman	1904
Bucelli	1897	Negro	1905
Williams	1899	Spieler	1910
		Wernstedt	1917

1. G. Haggqvist, "The Question of Spastic Paralysis," International Bulletin for Economics, Medical Research and Public Hygiene, New York, Nat'l Foundation for Infantile Paralysis, Vol. A 40, 1939.





Some of these cases presented only the spastic syndrome, while others were a combination of spasm with a flaccid paralysis.

Recently, because of the appearance of the Kenny Treatment, many research workers have engaged in physiological studies of spasm. I hereby present a few for the scrutiny of the reader.

Concerning muscle fiber anatomy. In the past, studies in poliomyelitis have centered around anterior horn cell research. Muscle fiber studies were neglected until the dissimilarity in the size of two children's legs stimulated a grant from the National Foundation of Infantile Paralysis. Both children had flail feet and all muscles graded zero. After a very detailed study of microscopic pathology of poliomyelitis muscle, Hipps, M.D.,<sup>1</sup> F.A.C.S. of Marlin, Texas, came to the conclusion that muscle fiber may still be normal even when it is on a stretch. It appears that muscles which appear paralyzed for years may come back when a contracture of the opponent is relieved. Orthopedic surgeons and physical therapists frequently see the return of an anterior tibial after a heel cord is lengthened.

R. Plato Schwartz, M.D. and Harry D. Bouman, M. D.<sup>2</sup> of University of Rochester did a study in oscillographic records of muscle action currents of seven patients with infantile paralysis, three with spastic paralysis, and three normal con-

---

1. H. S. Hipps, op. cit.

2. R. P. Schwartz, and H. D. Bouman, "Muscle Spasm in the Acute Stage of Infantile Paralysis as Indicated by Recorded Action Currents Potentials," Journal American Medical Association, 119: 923-926, July 18, 1942.





trols. This investigation showed that spasticity in poliomyelitis may be found not only in the antagonists of weakened muscles but also, in the weakened muscles. Furthermore, spasticity was noted in other muscles where no clinical signs of weakness were present. The conclusion from these record studies was that spasticity obtained in the reflex muscle is due to a reflex mechanism because it is produced by contraction or stretching of the antagonist. Therefore, spasticity is not due to contraction developing in the muscle because of termination of motor impulses, but is a true reflex. The authors illustrated records which showed clearly that spastic muscles which were not treated did not lose their spasticity. They gather, therefore, that there is a dissociation between the voluntary and reflex excitation of weakened muscles in poliomyelitis which does not exist in normal muscle.

This is a pertinent study to our investigation, for the conclusions substantiate Miss Kenny's doubted concept of the presence of spasm in poliomyelitis, both in the weakened muscles and in the antagonists.

1

In another article, the same authors criticize the individuals who have "O. K.'d" the role of spasm in poliomyelitis and have not shown scientific evidence to back up their claims. The authors state that they found spasticity present

- 
1. R. P. Schwartz and H. D. Bouman, "Degree, Extent, and Mechanism of Muscle Spasm in Infantile Paralysis," New York State Medical Journal, 44: 147-153, January 15, 1944.





in poliomyelitis, but question if it weakens the muscle. Their previous study <sup>\*</sup> indicates that the Kenny concept of spasm is an actual phenomenon in the early stage of poliomyelitis. They also state that they found no signs of action currents or spasticity in cases of complete paralysis after stimulation by stretch reflex or voluntary effort. This convinces them that the spasticity in poliomyelitis muscle is not due to a localized process, such as inflammation or fibrillation. They remain firm in their belief that spasticity is a reflex phenomenon. The conclusions are that because spasticity appears not only in the agonist, but also in the antagonist muscle which does not show weakening, spasticity is independent of muscle weakening. Spasticity in certain muscles is not necessarily followed by weakening of their antagonists. Therefore, spasticity and weakening are dependent on disturbance of specific functions of the horn cells and are two separate phenomena.

Another pertinent study is written up by Herman Kabat, <sup>1</sup> M. D., Ph.D., and Miland E. Knapp, M. D. of the University of Minnesota. In this article, the authors support the theory that muscle spasm in poliomyelitis is due to a pathologic condition—an internuncial neurone lesion in the gray matter of the spinal cord. An investigation of spinal cord pathology of 68 cases of poliomyelitis showed that almost every patient had an inter-

\*

"Muscle Spasm in the Acute Stage of Infantile Paralysis as Indicated by Recorded Action Currents Potentials."

1. H. Kabat and M. E. Knapp, "The Mechanism of Muscle Spasm in Poliomyelitis," Journal of Pediatrics, 24: 123-137, February, 1944.





nuncial lesion. They found twenty-six cases with internuncial lesions and comparatively normal anterior horn cells. 14 patients were studied with chronaxie tests. It was demonstrated that there is no correlation between spastic muscles and anterior horn cell damage. Therefore, anterior horn cell damage is not the basis of muscle spasm, because many spastic muscles showed normal chronaxie while others showed more or less marked increases in chronaxie.

Thus, we find that this "muscle spasm" is not completely understood. Although it is claimed that spasm may be found in every case, there seems to be no direct relation between it and motor paralysis. A great deal of research of muscle spasm mechanism is now going on. Results at present seem to accept the theory that spasm is a reflex phenomenon--and not the result of a process within the muscle. Current investigations lead to the belief that the spasm of poliomyelitis is neurogenic and is the result of the block of reflexes in the gray matter of the cord. This conclusion and also the finding that drugs and anesthesia influence spasm are encouraging for they promise scientific contributions to the treatment of muscle spasm in poliomyelitis.

The main object in the early treatment of infantile paralysis, according to Sister Kenny, is the elimination and relief of muscle spasm and pain. To be effective, the treatment should be started as soon as possible. This is very important and is accomplished by a specialized therapeutic procedure---





the application of hot fomentations to the areas involved. The object of this procedure is to relax the muscle fibers in order to enable the muscles to recover their elasticity, softness, full length, and receptivity to stimuli. The technique and discussion of hot fomentations will be found in Chapter VI.

#### MENTAL ALIENATION

"Mental alienation" is the second concept of the Kenny treatment of infantile paralysis. This so-called pseudoparalysis is believed to be a physiologic block--not an organic block, for there is no interruption of continuity of impulses between the central nervous system and the skeletal muscles. Although these alienated muscles are never tender or painful, they appear toneless and incapable of voluntary contraction. Not only do they appear toneless, they eventually atrophy even though they are normal muscle. It is Sister Kenny's belief that muscle alienation may be avoided or cured if correct treatment is administered. The condition of incoordination must be prevented or eliminated in order to avoid permanent paralysis. "Proprioceptive reeducation" as early as possible is also an important factor in her treatment.

Proprioceptive reeducation. Miss Kenny requires the patient to assume the fundamental position in bed--that of correct body alignment, or the "zero position". She claims that much attention must be paid to preserve and protect the normal relationship of the parts of the body in the supine position, for man, moving in an upright position, is an orthograde animal.







The body is said to be in the "zero" position when all the muscle fibers are relaxed with no contractions or stretching. However, a side position is permitted at night, and when certain joints are flexed in spasm, they are not forced. As soon as the pain and spasm are relieved, the correct position of body alignment may be taken.

When the spasm in the lower extremities has disappeared, the feet are placed against an upright board which is fastened to the foot of the bed. A more detailed description of this technique follows in Chapter VI. Miss Kenny cautions against classing this as a dorsiflexion splint of the feet. This treatment will have no part of splinting. The foot-board is used only for the purpose of providing a solid contact for the sole of the foot in order to stimulate and reestablish the normal standing reflexes. The patient is told to push against this footboard during the day because Sister Kenny believes that when the soles of the feet have contact with a solid surface, normal contraction of the standing muscles is stimulated and their function restored more readily.

"The standing position or orthograde posture of man is the result of reflex muscular activity induced by contact of the soles of the feet with a solid surface....The sole of the foot seeks the contact with a solid surface that use has mirrored upon the subconscious mind for years. When the patient presses the foot against the board, he causes impulses to arise in the cutaneous receptors which are transmitted to the proprioceptors





and result in stimulation of the standing reflexes." <sup>1</sup> Thus we find that the board which is placed at the foot of the bed to maintain the sensation of contact, is used to reestablish the normal standing reflexes which are comparable to the "stutz" reflex in other animals.

2

One of the basic elements of posture is extensor tonus. It is the basis of the general postural mechanism, and is controlled from the medulla, while some other specific postural reflexes are controlled by the cerebral cortex. We know that the basic postural mechanism is dependent upon kinesthetic impulses from the limb muscles stretched or extended in the movement of the body. We also know that the kinesthetic receptors act as an inhibiting mechanism by resisting the reflex. This smooths out the response and produces better coordination. Again we find that the Kenny Treatment rests on the firm foundation of physiological psychology findings.

Although the concept of "spasm" appears to be a physiological problem, many claim that it is a psychological problem also; the concept of "mental alienation" appears to be a purely psychic term. Miss Kenny claims it is loss of mental awareness or a proprioceptive dissociation. She believes that the subconscious tends to reconstruct and accommodate itself to accept all changes as permanent. This deliberate change creates the

---

1. Pohl and Kenny, op. cit., p. 288.

2. C. L. Morgan, op. cit., p. 340.





condition of incoordination. For example, when abduction is desired, the adductors will contract trying to assist in abduction. In order to avoid this muscle function substitution, the patient is instructed to concentrate his attention on the point of insertion of the muscle or tendon.

<sup>1</sup>  
Steindler, Russin, Sheplan, and Walkin did a study on 200 patients in the 1940-1941 Iowa epidemic. They found that 25% had some kind of residual contractures. Especially prone to contracture were the paralyzed muscles which had been treated by prolonged immobilization, quadriceps muscle contractures, treated with extension splints, being most common. The authors became convinced that there is more to the pathological picture of poliomyelitis than involvement of the motor neurons of the anterior horn cells. For example, they found signs of circulatory impairment and definite bone changes in the area of muscle involvement. This they believe to be of sympathetic involvement origin. Further investigation led them to believe that bones, tendons, ligaments as well as muscles are affected by anterior poliomyelitis. These pathologic changes were found in knee, elbow, shoulders, wrists, and fingers. Their most pertinent observation was the conclusion which they came to. They found that when the patient was not able to contract or activate an affected muscle, he immediately began a substitu-

---

1. A. Steindler, L. A. Russin, L. Sheplan, and V. Walkin, "Recent Changes in the Concept of the Treatment of Poliomyelitis," Archives of Physical Therapy, 23: 325-331, June 1942.





tionary motion. This study is brought to the attention of the reader to point out the fact that here, independent of Sister Kenny, medical people are finding signs of "mental alienation" and "substitution" which consequently leads to "incoordination."

Another instance of mental alienation not due to infantile paralysis which is frequently seen by orthopedic men and physiotherapists may be recalled at this time. It is the inability of some patients to contract the quadriceps muscle after a knee operation or other joint lesion. There is nothing wrong with the muscle itself; the patient should be able to contract it--yet reeducation is often needed for a long time before mental awareness is established. Yet the Kenny concept of mental alienation has called forth considerable criticism and debate.

In summary, therefore, we find that on investigation the Kenny concept of "mental alienation" is probably a physiologic block<sup>1</sup> in conduction. This is not to be confused with the temporary paralysis of poliomyelitis due to the non-lethal damage of the anterior horn cells which would recover spontaneously after the acute phase of the disease. It also includes much more than this; it is also a psychologic block. In the discussion of her concept of "mental alienation", Sister Kenny<sup>2</sup> writes that changes in the subconscious mind are responsible for "loss of mental awareness" of a muscle or group of muscles.

---

1. Pohl and Kenny, op. cit., p. 42.

2. Pohl and Kenny, op. cit., p. 147.





She is convinced that when a limb has been immobilized, the patient loses the consciousness of possession--a sort of mental detachment. There are two aspects to be considered: (1) loss of mental awareness or proprioceptive function and (2) mental alienation which is loss of motor function. Because these conditions respond so well to the Kenny reeducation system, which is chiefly psychotherapeutic in nature, it seems apparent that the paralysis in poliomyelitis is due to a failure of the proprioceptive and motor functions as well as to the neuro-physiologic disturbances.

Mental Awareness. The goals of the Kenny treatment of poliomyelitis are the correction of "mental alienation" by means of a very exact system of muscle reeducation and the reestablishment of "mental awareness" by sensory stimulation and passive motion. Miss Kenny aims to accomplish these goals by combining physiotherapy with two methods of psychotherapy--the well established "suggestion" and "reassurance". The physical therapist assists the patient through passive motions, as is explained in Chapter VI, in order to reestablish "mental awareness" through proprioceptive function. The technique of the physical therapist is to trace the exact course of the muscle from origin to insertion with her fingers. The aim here is to connect the patient's consciousness with the more concrete sensation of touch by means of suggestion. The patient then attempts active motion, but is closely supervised and assisted in the attempt, for under no circumstances, should an inaccurate





motion be allowed. Great care <sup>should be</sup> taken to have the patient know the name, location, and action of the muscle or group of muscles which he is to exercise. The patients get great satisfaction from this accomplishment and the whole outlook is optimistic. Of course, the patient's improvement depends upon his ability to react to suggestion and physical therapy. Whereas the Orthodox Method of treatment of poliomyelitis concentrated on re-education by increase of muscular strength, the Kenny Method aims to reestablish grace and maximum efficiency to muscle action through motor and proprioceptive functions.

As has been stated, the atmosphere is an optimistic one. In giving the Kenny treatment, the physical therapist's attitude gives reassurance to the patient that he is capable of a given motion of a muscle or group of muscles. The patient is encouraged by this and he tries with all his faculties to reestablish effective, coordinated active movement; he takes an increasingly active part in his treatment. Henri de Mondeville, a medieval physician, wrote the following, back in the thirteenth century: "Keep up your patients' spirits by music of viols and ten-stringed psaltery, or by forged letters describing the death of his enemies, or by telling him that he has been elected to a bishopric if a churchman." We know from experience that a patient "with a will to live" does more often survive an illness than the patient who "wants to die". There may even be the possibility that depression and anxiety in some patients prolong the condition of "mental alienation". In comparison with this





cheerful atmosphere, we have the atmosphere of gloom and dread of the disease which was prevalent in the orthodox treatment. It was this feeling of "do nothing," this "here's hoping you won't be badly hit" which characterized the splinting and immobilization period. It created in the patient's mind the idea and belief that active motion is both forbidden and impossible.

The Kenny Method cautions against leaving the patient with the impression or feeling of failure. Every exercise carried out must be completed with success. This is definitely a principle of psychotherapy. If the patient should accidentally execute a correct motion which he was earlier unable to accomplish, exercise for the day is to stop. This, Miss Kenny says, is to be done so that the patient will not forget it and he will also be in a better frame of mind for his exercises the following day. Furthermore, over-enthusiasm, leading to repeating of the exercise, on the part of the patient, physical therapist, or parent may bring about a state of fatigue and also a loss of mental awareness which had just been reestablished. "If attention should flag during the treatment session, it is best to discontinue the treatment for the time being. If possible, each time the patient should be left with a sense of achievement and a desire to continue his efforts at the next session on the following day. A cheerful and optimistic attitude should be encouraged at all times".<sup>1</sup> Thus, the patient goes through the day

---

1. Pohl and Kenny, op. cit., p. 179.





with a feeling of encouragement and triumph instead of pessimistic failure. His concentration and effort the next morning are bound to be excellent. Miss Kenny also states that the physiotherapist must try to sense how much effort the patient is making. As quoted above, if this effort shows indifference or the movements are incorrect, the exercise period is discontinued until better cooperation can be obtained. Thus, a thoroughly sound teaching, i.e. reeducating, program is provided which affords the patient emotional security and provides daily goals for which to strive and by which progress may be measured.

#### INCOORDINATION

The third concept of the Kenny method of treatment of infantile paralysis is "incoordination." Incoordination is that condition in which a muscle tends to substitute for the muscle which should normally function to perform a certain motion. This is an unhealthy condition in which there is a physiological interruption which produces a "twist" or "distortion" in neuromuscular function. Thus we find that a disturbance in normal motor patterns may cause the development of new motor patterns. Whether this disturbance may be due to spasm, alienation, or paralysis, it is necessary to restore action through normal patterns before normal action can take place. These incoordination phenomena may be detected in different manifestations; by spilling-over of impulse to other unrelated muscles, by spilling-over of impulse to opponents of the desired action, or by substitution. One often sees the acting and opposing group





attempting to contract together. Often, the normal rhythm of the muscle contraction is disturbed and the contraction may occur at the origin only. As would be expected in such an instance, the efficiency of the muscle is greatly reduced. Immediate treatment to restore rhythmic muscular activity should be instituted as soon as this condition is noted. In such cases, Miss Kenny would discontinue exercise until this fundamental condition is overcome.

Proof for the actuality of this concept are the results which Miss Kenny gets with her treatment. Many patients have come to her who have had orthodox treatment for months or years. After treatment with the Kenny method, they get an increase in useful function and decrease in limitation of motion which was caused by muscle contractures. Thus through an increase in coordination, they are able to use parts previously partially or totally useless and often are able to walk without support. Surprisingly enough, in most cases, a muscle test might show a small increase in muscle power or no increase at all. Observers<sup>1</sup> tell us that patients who receive the Kenny treatment from the beginning are able to successfully use their muscles with rhythm although a muscle test would reveal very slight muscle power present.

All motor skills are initiated and carried on through the

---

1. Pohl and Kenny, op. cit., p. 355.





pattern of a set,<sup>1</sup> which, in turn, is governed by many factors. The process of learning takes place through trial-and-error, which is directed by complex sensory controls in combination. The latter are the visual, auditory, and kinesthetic faculties. Under instruction, the process of trial and error is minimized, for wrong coordination is prevented and the learning process improved and accelerated.

The laws of learning. In education, teachers have been guided by rules--rules which have grown out of the study of human nature. For example, the first law of learning is often called the law of exercise. "This law assumes that between a sense organ and any given set of muscles there are pathways of conduction, the exercise of which will lead to an increase in strength of the connection or to an increase in readiness for conduction. As a corollary of this law of exercise, there is the law of regency which says that the more recently a connection has been exercised, the stronger will be the connection. Likewise, one may say that the disuse of any series of connections<sup>2</sup> will result in the weakening of that series." The Kenny Treatment lays its foundation on this basis. Just as soon as the acute spasm has been alleviated, Sister Kenny advocates the immediate commencement of passive exercises followed by an ac-

1. W. C. Trow, Introduction to Educational Psychology, Boston, Houghton Mifflin, 1937, p. 235.
2. C. R. Griffith, An Introduction to Applied Psychology, New York, The McMillan Co., 1934, p. 615.







tive exercise. If it is indeed true that the pain reflex inhibits normal function of a muscle, it is obvious how necessary it is to bring the nerve conduction to normal as soon as possible.

Then, we have the law of effect which states, "Other things being equal, any connection will be strengthened which leads to or is accomplished by a feeling of satisfaction, whereas any connection will be weakened which leads to or is accompanied by a state of annoyance."<sup>1</sup> Again we find that the Kenny treatment excels. If the patient were moved during the extremely acute stage, the treatment would not be educationally sound, for these patients are very sensitive and excruciatingly tender. Sister Kenny treats this spasm with hot fomentations which are soothing and relaxing. An example of this may be illustrated by the incident told by Miss Kenny herself.<sup>2</sup> Miss Kenny had taken off the fomentations to reheat them. The little stricken girl had received such relief from them that she cried out, "I want them rags that wells my legs." At the first moment that the extreme painfulness is gone, the Kenny system recommends motion. Is not life motion? Without motion there is no life.

In summary, "muscular incoordination," as described by Miss Kenny, appears to be the natural consequence of "loss of mental awareness," and "mental alienation" as well as of pain of movement, of muscular spasm and actual paralysis. It is due

- 
1. C. R. Griffith, Op. cit., p. 618.
  2. E. Kenny, And They Shall Walk, p. 24.





to the inability to properly contract specific muscles.

### MUSCLE REEDUCATION

There is no doubting it: the Kenny Method requires almost constant attendance. The technicians must be thoroughly trained in the technique; for spasm must be recognized, muscle soreness must be detected for the immediate application of the packs, and alleviation of soreness must be immediately "spotted" so that active rehabilitative procedures may be started.

Muscle analysis. According to Sister Kenny, the most important factors to consider in order to analyze the condition of the patient with poliomyelitis are:

1. What muscles are in spasm?
2. What muscles are incoordinated?
3. What muscles are alienated?

Muscle classification and synchronization. The immediate task of the treatment of the "symptoms of the disease" are the elimination of the spasm, incoordination, and mental alienation. Having eliminated the spasm with the hot fomentations, an active program of reeducation is begun to overcome incoordination and mental alienation. In order to do muscle reeducation, a thorough knowledge of the classification and synchronization of muscles is necessary.

The objectives and methods of muscle reeducation to produce normal functional activity. According to Miss Kenny, the objectives of muscle training of poliomyelitis should be:





1. To establish coordination.

2. To overcome mental alienation.

To attain these objectives, her methods are: (1) Relaxation; (2) Passive movements or exercises; (3) Muscle stimulation; (4) Directed active movements and exercises. Later treatment of the Kenny Method consists of: (1) Avoidance of substitution of muscle power; (2) Physiologic stimulation of muscles; (3) Concentration of attention and effort on the insertion of muscles. Her method of reeducation requires much mental concentration on the part of the patient, for she lays much emphasis on developing coordination and normal muscle rhythm from the first. Our neuromuscular system is by no means simple; it is highly specialized and complex.

We have already discussed the fact that although each muscle has a definite primary action, which is a direct pull on its insertion, it seldom acts alone (see Chapter IV, **MUSCLE TESTING**) because the neighboring muscles join in the movement. Thus, although we call a muscle a "prime-mover" of a joint, we must admit that other proximal muscles come into play. We have also discussed the principles of reciprocal innervation which tells us that for every motion performed by one muscle, e. g. agonist, there is an opposite motion performed by the antagonist. The nervous system controls the blending of these two roles and produces proper functioning of the muscles of the body, which we call coordination. "Coordinations are learned habits and it is only by forcing the habit of performing acts into the lower





centers that one is actually free to do things. Coordinations thus becomes an affair of the whole organism. There is at the bottom a relationship of mind and body."<sup>1</sup>

We find, therefore, that adjacent muscles attempt to substitute for the weak or disabled muscle whether the condition is caused by muscle pathology or "mental alienation". It is for this reason that Miss Kenny states that muscle training must prevent or remove muscle substitution which leads to incoordination. The patient must make utmost mental as well as physical effort to train the weakened muscle only. Nothing else will do, and Sister Kenny allows the patient no free motion whatsoever, for fear of creating an undesirable substitution.

As has been stated, the entire body must be completely relaxed, mentally as well as physically, before the muscle training period begins. The physiotherapist then carries through the passive movements with the purpose of stimulating the fibers and reestablishing "mental awareness" of the muscle. Thus Miss Kenny makes use of the proprioceptive nervous reflex system with the purpose of restoring subconscious motor centers connections. This muscle stimulation procedure is abandoned when active muscle control is returned. The physiotherapist then calls the patient's attention to the origin and insertion of the muscle be-

---

1. J. B. Nash, Mind Body Relationships, in Interpretations of Physical Education, Vol. I, New York, A. S. Barnes, 1931, p. 27.





ing trained, and instructs the patient to follow the motion mentally with no physical effort. While three passive motions are given to the various muscles being trained, the physiotherapist must be watchful that the adjacent muscles are not coming into play. If such action should take place, Miss Kenny says that the patient is not concentrating properly and is not completely relaxed. Treatment is interrupted until complete physical and mental relaxation is obtained. Her object of this procedure is to restore the connection between the central nervous system and the insertions of the involved muscles through mental awareness and coordination.

Miss Kenny claims that in a short period of time, perhaps days or weeks, there should be signs of subconscious control. The physiotherapist may test the patient every few days by asking him to attempt an active movement to see if the brain path has been reestablished. She should watch for a sudden involuntary contraction during the passive movement or the muscle stimulation exercise. When the connection is made, the patient is permitted active movement and is allowed conscious control of the muscle. At this time, the physiotherapist carries through only two passive movements and requests the patient to actively contract the third movement. When the patient is capable of doing this, this procedure is repeated every exercise period--but always under the supervision and guidance of the physiotherapist. Even when the patient is allowed two and finally three active movements, they must be taken under the guidance of the





physiotherapist. If, at anytime, the technician should observe any signs of incoordination, passive motion is resumed and active motion stopped until the involved muscle becomes coordinated and blends with proper action of adjacent muscles again. As with the orthodox system, when active motion is easily carried through, resistive movements may be given.

A very interesting and detailed series of experiments were carried through by Jacobsen<sup>1</sup> which is very pertinent to our present study. Action potentials of the different muscles of the body were studied while the subject went through various "mental" thoughts which were controlled by instructions. After the subjects were relaxed, they were instructed to think of the words of a song or to add, multiply, or subtract mentally. Here the lips and tongue muscles were found to contract. When the subject was told to visualize an object, the muscles of the eye were found to contract. And so on, to all forms of mental muscular activity--he found that the specific muscle groups which would have caused or carried through the action physically, also carried through the action mentally. The Kemy method without

---

I. E. Jacobsen, "Electrical Measurements of Neuromuscular States During Mental Activities," American Journal of Physiology.

- I. "Imagination of Movement Involving Skeletal Muscle," 91: 567, 1930.
- II. "Imagination and Recollection of Various Muscular Acts," 94: 22, 1930.
- III. "Visual Imagination and Recollection," 95: 694.
- IV. "Evidence of Contraction of Specific Muscles During Imagination," 95: 703, 1930.
- V. "Variation of Specific Muscles Contracting during Imagination," 96: 115, 1931.
- VI. "A Note on Mental Activities Concerning an Amputated Limb," 96: 122, 1931.
- VII. "Imagination, Recollection & Abstract Thinking Involving the Speech Musculature," 97: 200, 1931.





risking incoordination, i.e. substitution, administers passive motion. Since it does seem that the same neural pattern is brought into play whether the act is actually physical or merely mental, we may expect (provided there is some life in the anterior horn cells) that stimulation of movements symbolic of certain brain paths plus mental exercise of these brain paths may restore normal function. It seems, therefore, that the Kenny method of muscle reeducation is based on a scientific basis.

It is also plain to see that the Kenny method does not abolish "rest", for rest is still a very essential necessity in poliomyelitis. On the contrary, the Kenny Treatment goes a step farther; it teaches relaxation.<sup>1</sup> She instructs older children to keep as quiet as possible. According to Miss Kenny, "The small child is still largely an automatic mechanism with little selective control of muscle. There is, therefore, less tendency for substitution of muscle and incoordination of muscle to develop. Voluntary efforts of the small child are less harmful to the disturbed neuromusculature than are those of the mature child or adult."<sup>1</sup>

Therefore, we find that the Kenny method of muscle training is a supervised, extremely detailed method of directing the patient's attention toward the accomplishment of one task--the contraction of one muscle alone. Trial and error learning will

---

1. Pohl and Kenny, op. cit., p.95





not do; imagination will not do. This system of reeducation calls the sense of vision into play for the muscle is pointed out by the physiotherapist's hand. The patient learns exactly where the muscle which he is to contract is located and watches for the complete muscle to contract. Even if the muscle does not contract he is still left with the feel of the passive movement and is thus in a better frame of mind to attempt it another time. It is amazing to one who watches a group of children being treated by the Kenny method to see how well these children know their anatomy. This brings us to an interesting phenomena to illustrate the scientific basis of this phase of the Kenny method of muscle training.

The muscle name phenomena of motor conduction. In an experiment, <sup>1</sup>Weiss has shown that a pattern of movement is determined by the muscles which carry it through rather than the functional significance the movement might have had. Weiss says that the "name" of the muscle determines its action. The Kenny method attempts to do just that in the process of reeducation. Since each muscle "knows its name," the effort is made to put out a "call" from the central nervous system for its activity, no matter how disposed the brain path may be.

An example of how much can be done for an organic lesion which is considered incurable is the use of Frankel's Method

<sup>1</sup> P. Weiss, "Self-differentiation of the Basic Patterns of Coordination," Comparative Psychology Monographs, Vol. 17, Number 4, Serial Number 88, Baltimore, Maryland, The Williams and Wilkins Co., September, 1941.





of Treatment for locomotor ataxia.<sup>1</sup> These patients are taught the exercises or detailed motions of walking and, surprisingly enough, actually show improvement in coordination. Whether this is due to the training of the eyes to replace the muscle sense, whether other brain paths take over the function of the degenerated nerves, or whether the muscle sense is actually reeducated is not known. But here we have a completely hopeless case of organic lesion origin--and nature is able to compensate. As in the Kenny Method, these exercises require undivided attention from the patient. This is an illustration of a condition which may be treated by a therapy which resembles the Kenny therapy, and which has survived the test of time. Both methods call for complete mental interest with the use of suggestion to make the patient concentrate on one idea only.

Learning has rightfully been called the most remarkable process in this universe. Repetition alone is not sufficient for learning; many factors influence the process. To learn or acquire a skill, favorable conditions for learning should be provided. The Kenny treatment attempts to provide an atmosphere of hope, optimism, and shows no trace of failure possibility. Because our nervous system is so complex, there is much we do not know about the laws which control it. There are, however, many facts which we have established from the various studies

---

1. J.J. Walsh, Psychotherapy, New York, D. Appleton-Century, 1912.





on the process of learning. One of these is that a person should know that he is working toward a certain achievement. Since we are intelligent human beings, we desire to know what our goal is, and our ego is flattered when our superiors take us into their confidence. Disinterest has been noted among factory workers who, day in and day out, make one certain gadget. Rate of production has been speeded when these same factory workers were shown the part this "gadget" plays in the assembling of the "whole". We may deduct, therefore, that:

- "1. Practice makes perfect only when we obey the laws and principles of learning.
2. Unless the learner makes a strong resolve to learn, and unless he attends strictly to his task, his rate of improvement will be low.
3. The resolution or the intent to learn must be supported by as many incentives as the learner can find in his own experience. Common incentives are:

Knowledge of goal toward which he is working.  
Feeling of attainment or success.  
Knowledge of "scores"--successes and errors.  
A hopeful, optimistic attitude. "

1





## CHAPTER VI

### THE KENNY METHOD OF TREATMENT OF ANTERIOR POLIOMYELITIS

#### THE KENNY TECHNIQUE

The main consideration of the Kenny method of treatment of anterior poliomyelitis is the relief of muscle spasm and pain in order to protect the neuromuscular system--as far as possible. This treatment must be begun at once--immediately on diagnosis--by the application of hot fomentations, which, Miss Kenny says, relieves spasm better than any form of dry heat. The proprioception or muscle sense is also protected, for the patient must keep the soles of his feet in contact with a foot board. The purpose of the fomentations is to restore the muscle fibers to normalcy so that muscle training may be started.

#### POSITION OF NATURAL REST IN BED

On admission, the patient is placed on a rigid bed. Not only are boards placed under the mattress, but also at the foot of the bed. The patient is instructed to keep contact with this foot board in order to maintain the normal standing reflexes which are similar to the "Stutz" reflex in animals. This reflex induces the normal contraction of all standing muscles when the sole of the foot comes in contact with a hard surface. The





foot board is not used when painful spasm of the plantar flexor or posterior leg muscles is present.

The patients are turned to the prone position twice a day for an hour. This idea is not a new one, but is similar to the Silver <sup>\*</sup> Method of preventing stasis of circulation by special postural measures in bed. Some twenty years ago, Dr. David Silver suggested the idea of changing the position of the patient in bed to improve the circulation of blood in the posterior trunk and spinal column. In those days, it was common for patients to lie on their backs for days or weeks in splints with no change in position at all except for morning nursing care. Because patients were tender and had so much pain on motion, there was a tendency to let them stay put. Dr. Silver suggested a system of turning the patient in one unit periodically, every two hours or so, and supporting the extremities in advantageous physiologic positions. This postural program is still used with variation according to the individual case. Even when the patient is lying in the prone position, his feet are pressed against the foot board. This is possible because the mattress is pulled up toward the head of the bed and there is a space between the mattress and the board for the feet. It is Sister Kenny's aim to preserve the patient's feeling of con-

---

\* David Silver, M.D., Professor Emeritus of Orthopedic Surgery, University of Pittsburgh School of Medicine.





tact with the floor so that when standing is permitted, the sensation will not be lost.

The body is kept in the "zero" position, which is the position, Miss Kenny claims, when all muscle fibers are at rest. Side positions are not permitted, and all exercises are given from either the supine or prone position. All pressure, especially on bony surfaces, is avoided. The heel rests, of course, in the space between the mattress and footboard. The wards in which these patients are treated are kept unusually warm (which, to be sure, is trying on the nurses and physiotherapists).

#### THE TREATMENT OF SPASM OR THE APPLICATION OF HOT FOMENTATIONS

The fomentation is a method of hydrotherapy. Hydrotherapy is that branch of medicine which treats disease by means of water. Water is an agent which provides one of the most ancient methods of treating disease, for it is, and has been, so universally accessible and is capable of producing a great many physiological effects. The use of hydrotherapy goes back to ancient times, but it is only within the past century that actual experimentation and data placed it upon a scientific basis.

Physiological Effects. "The fomentation is a powerful excitant measure, stimulating tissue activity, increasing metabolism or tissue change, quickening the circulation and gen-

---

I. J. H. Kellogg, Rational Hydrotherapy, Second Edition, F. A. Davis Company, Philadelphia, 1904; p.





eral nutritive processes, and encouraging absorption and repair.<sup>1</sup>"  
As with other forms of hot applications, the hot fomentation has two effects; excitant and sedative. If it is applied at extremely high temperatures, it causes a temporary blanching because of the contraction of the small vessels and later on relaxation or paralysis of the constrictors. Very hot applications also lessen the sensibility of the cutaneous nerves and greatly alleviate pain, for the surface vessels are dilated and produce a local hyperemia and collateral anemia. When a pathological process is present, there is reason for Nature causing an increase in heat to the part affected by creating an inflammation. This is not simply an incidental result. Fomentations are a means of aiding Nature. "An examination of the blood of the part to which the fomentation has been applied for a short time shows a notable diminution in the proportion of the hemoglobin and red cells and an increase of white cells to two or three times the normal. Hot applications encourage migration of the white cells and thus leucocytosis. The actual number of blood cells in the part is, however, greatly increased because of the increased volume."<sup>2</sup> The fomentations advocated by Sister Kenny are very hot, wrung out of boiling water. We may recall that Sister Kenny also believes the spasm of poliomyelitis is due to an ischemia; fomentations are certainly indicated, therefore.

---

1. J. M. Kellogg, op. cit., p.796.

2. J. M. Kellogg, op. cit., p.797.





The idea of employing moist heat in poliomyelitis is not new, for Lovett writes that he and his assistants used hot packs in 1916. They found them quite effective in alleviating tenderness and pain. However, his patients were not seen until after quarantine was over and packs were administered for half hour periods only two or three times a day. As has been stated, the method of application of hot packs as used by Sister Kenny begins when diagnosis is made, and the packs are applied for the relief of muscle spasm.

Description of the hot wet pack. Hot fomentations or wet packs are prepared by placing strips of woolen blanket material into a sterilizer and boiling them for 20 minutes. They are then lifted out with a forceps, placed into a mobile tub, and wheeled to the patient's bedside. There, they are wrung through the wringer as thoroughly as possible (two or three times)--for excess moisture may cause a burn--and applied to the "muscles in spasm". Over these wet packs is placed: (1) a layer of oil silk (2) a layer of warm dry woolen strips. Miss Kenny insists that these packs be applied from one joint to another; they should never cover the joint itself, for that would enclose the tendon insertion. Changes may be made every half hour for the first 24 to 48 hours. In some cases, this procedure is continued 24 hours a day; in most cases, packs are discontinued for the night. In seriously ill patients, fomentations are changed as fast as they cool. When the extremely sensitive stage has passed, fomentations may be changed every two hours and discontinued for the





night. Sister Kenny's principle is that the fomentants are put on very hot, and remain hot for about 15 minutes. They gradually cool down, and that cooling down process is good for the muscles<sup>1</sup> and nerves.

Of course the question occurs as to whether the fomentation is more effective than another form of heat for relieving the acute stage of spasm. Dry heat stimulates sensory nerve endings, while moist heat decreases sensory afferent impressions reaching the central nervous system, and gradually cools, giving a vasomotor tonic effect which has been described in some detail<sup>2</sup> above.<sup>3</sup> Hall, Schamp, Brown, and Davis of Stanford University, demonstrated, by experiment, that the Kenny fomentation lowered the power of voluntary contraction of the flexor muscle of the forearm by 10%. The authors admitted, however, that there was not a great reduction of muscle power when packs were applied to most of the body surface. The conclusion reached was that these effects probably resulted because moist heat arouses reflex effects of sensory impulses in skin and subcutaneous tissues.

Because treatment with fomentations necessitates so much<sup>4</sup> attention and time, Stone did a study on artificial fever treat-

---

1. Pohl and Kenny, op. cit., p.117.

2. J. M. Kellogg, op. cit.

3. V. E. Hall, H. M. Schamp, G. E. Brown, M. N. Davis, "Effects of Kenny Fomentations on Strength of Voluntary Muscular Contractions in Man," Archives of Physical Therapy, 25: 96-99, February, 1944.

4. S. Stone, "Artificial Fever and Vitamin Therapy in the Treatment of Anterior Poliomyelitis," Archives of Physical Therapy, 24: 350-361, June, 1943.





ment. Eleven patients with poliomyelitis were given artificial fever plus oral and parenteral vitamin therapy. He reported that spasm was relieved, pain was alleviated, texture of the skin and circulation improved, and affected muscles strengthened. All the patients were able to take the treatment with no ill-effects. He concluded, therefore, that artificial fever and vitamin therapy not only did the work of fomentations more easily but also that it would regenerate some neurons not completely destroyed by the virus. This study is cited to illustrate to the reader that the introduction of the Kenny fomentations has stimulated experimentation.

It is a long known fact that heat produces muscular relaxation. The introduction of Sister Kenny's moist "fomentations" has stimulated newer studies, such as the one cited above and also the study previously cited on the effects of various forms of heat on muscle and on the degree of relaxation produced. Having seen the Kenny treatment under operation, and having compared it with the orthodox, the writer has no doubt that by this method of hot fomentations, the pain disappears more quickly than by any other.

#### MUSCLE TESTING

The Kenny technique does not allow muscle testing. Sister Kenny believes that muscle testing, which, incidently, has never been completely accurate (See Chapter IV, MUSCLE TESTING) in the acute stage of infantile paralysis, is definitely dangerous because of the likelihood of exaggerating spasm or of producing





incoordination and "alienation."<sup>1</sup>

### THE RESPIRATOR

The Kenny technique does not sanction the use of the respirator. Its use is not permitted because Miss Kenny believes spasm in the intercostal muscles can only be aggravated by the mechanical pulling on the ribs and, also, treatment with the respirator does not allow for the treatment of the spasm with hot fomentations. She says that muscle testing and the respirator do not help respiratory difficulty and may be harmful. Her treatment consists of hot packs which are applied to the pectorals and around the neck to include the sternocleidomastoids. She also applies these packs to the entire spine to be renewed when the patient says they are cold. The muscle reeducation program attempts to restore the "brain paths" by giving the patient the following exercise: inhale and expand the thorax; exhale and contract the intercostales interni. The physiotherapist gives her assistance in the latter movement by gently depressing the floating ribs.<sup>2</sup>

### MASSAGE

The Kenny technique does not permit the use of massage. Sister Kenny writes, "Massaging or rubbing excites spasm and is very damaging to the sensitive muscle tissue."<sup>3</sup>

### MUSCLE REEDUCATION

As soon as spasm has been relieved and the joint can be

- 
1. Pohl and Kenny, op. cit., p.174.
  2. Pohl and Kenny, op. cit., p.128-130.
  3. Pohl and Kenny, op. cit., p.98.





moved passively without incoordination or pain, the active program of muscle reeducation may be started. The patient is told that he must concentrate only on the motion to be performed and that he must not use any muscle except the ones being treated. Holding the part to be treated with a firm grasp, the physiotherapist carries the part to be treated through two passive movements--through the full range of motion without causing pain. After pointing out the insertion of the muscle or muscle group and showing the patient the exact location of the same, the physiotherapist tells the patient the name of the muscle and what its action is. She then strokes the insertion of the muscle or muscle group and tells the patient to carry out a third active movement. If an unwanted muscle should come into play, the physiotherapist instructs the patient to press his finger against this muscle and thus attempt to eliminate it. The play of this unwanted muscle, if left unchecked, would cause incoordination, and the technician and patient must guard against this possibility. The patient must not be given muscle training if he is tired; when symptoms of non-cooperation or fatigue are noticed, Miss Kenny instructs the physiotherapist to discontinue treatment. Whether the muscle is paralyzed or "alienated", even if it cannot contract actually, Miss Kenny desires that it be made to contract mentally. If any sign of returning function, such as a tendon flicker or palpable contraction, is observed, the physiotherapist should stop treatment immediately. Of course, as the patient improves and is able to move more muscles,





more movements may be given, gradually increasing the number and range of motion.

Only two positions are used: supine and prone--never the side-lying position. For the proper operation and understanding of the Kenny Method of muscle reeducation, a knowledge of Sister Kenny's classification is essential.

Classification of Muscles. Miss Kenny classifies muscles as follows:

1. All muscles causing inward rotation of a joint contract within their normal resting length to perform this action. Therefore, to shorten them means an eventual limitation of this movement, either in flexion (psoas muscle) or abduction (gluteus medius) in the lower extremities; or shortening (coracobrachialis) in flexion, and (the deltoid) in abduction of the upper extremity.

2. All muscles that are removed from their normal resting length before a satisfactory contraction can occur. All hinge joints are stabilized by muscles which come under this second classification. Therefore, when the head of the femur is rotated backward, the psoas muscle flexes the thigh forward; when the head of the femur is rotated forward, the hamstrings lift and support the thigh in extension. When the quadriceps contracts, it stabilizes the lower limb and protects the hinge joint from collapsing during weight bearing. In order for it to function effectively (contract), it must be removed from its normal resting length. When the gluteus maximus contracts, it

---

1. Pohl and Kenny, op. cit., p. 155-172.

2. E. Kenny, op. cit., p. 40-41.





stabilizes the limb in extention. The same law applies to the upper extremity. For an effective contraction, the triceps must be removed from its normal resting length. Regardless of what degree of paralysis may be present, the brain path must be restored through this routine which is based upon definite laws of kinesiology. If the joints are placed in abnormal resting positions, capsular ligaments are stretched, muscles shortened or overstretched, and worst of all: proprioceptive reflexes are obstructed.<sup>1 2</sup>"

A muscle analysis is made on daily rounds by Miss Kenny because the various affected muscles of a patient may be in different stages of recovery and must be treated accordingly. As previously stated, the physiotherapist directs and guides all exercises until the entire body is restored to full coordinated motion. The ultimate aim is to obtain a coordinated whole which functions with graceful rhythm, rather than placing emphasis on obtaining strength of individual muscles or groups of muscles.

In summary, therefore, we find the Kenny method of muscle reeducation teaches the patient to use his paralyzed muscles only, while all other muscles are kept in a state of relaxation. Muscles are stimulated physiologically through their tendons and the proprioceptive reflex system. In order to avoid and correct substitution of muscle function, Miss Kenny supervises these exercises by directing the undivided attention of the patient to the insertion of the muscle or tendon being trained.

---

1. Pohl and Kenny, op. cit., p. 155-172.

2. E. Kenny, op. cit., p.40-41.







The visual and tactile senses are brought into play when the physiotherapist strokes the skin over the muscle and tendon being trained in order to obtain and hold the attention and concentration of the patient. **Classification of muscles:**

- Most important groups
- "Group 1. Consist of muscles that contract within their normal resting length. Examples are: biceps and hamstrings.
  - Group 2. Muscles that have to be removed from their normal resting length before a suitable contraction can occur to perform their primary action. Examples are: triceps and quadriceps.
  - Group 3. Muscle groups with separate origin and common insertion and multiple action.
  - Group 4. Muscle groups with dual origin and dual insertions and multiple action.
  - Group 5. Muscles that stabilize positions obtained by other muscle groups."

1

Thus we find in the Kenny system that, with very detailed muscle training, the patient is made aware of muscle insertion--not joint action. First of all packs are employed to alleviate spasm and obtain normal length of muscle and tendon. Miss Kenny does not advise massage or the respirator because she claims they increase rather than decrease spasm. Her muscle reeducation program has no place for muscle testing because of the possibility of encouraging substitution and incoordination. Emphasizing coordination instead of muscle strength, Miss Kenny advises two reeducation periods per day with one to three con-

---

1. E. Kenny, op. cit., p. 124.





tractions (two passive and one active). However, a muscle in "spasm" should not be irritated by active or passive motions; so it is not until spasm has been relieved that exercises are begun. Emphasis is placed on "mental awareness" or making the patient muscle conscious. Observers \* tell us she has a remarkable ability to obtain cooperation, both mental and physical, from patients of all ages. Undoubtedly, she is a teacher of unusual ability. Even in cases where paralyzed muscles cannot be moved, she teaches patients to attempt to put through impulses while passive movements are carried through by the physiotherapist. There is no possibility of failure (inability of function) suggested to the patient in any way. She takes a psychological as well as physiological approach to the problem.

The Kenny treatment of poliomyelitis enables the patient to take an active part in his education for normal function; his mind as well as his body are called upon to take responsibility of this task.

---

\* The Minneapolis Group: Drs. Cole, Pohl, and Knapp.





TABLE III

" PHYSICAL UNIT: A special physical unit will simplify the application of the Kenny Method especially in a hospital where several patients are under treatment at one time.

COMPONENTS: Trained personnel, equipment.

PERSONNEL: M. D., physiotherapist, nurses, orderly.

ADDITIONAL PERSONNEL DESIREABLE: Pediatric Resident, Orthopedic Resident.

EQUIPMENT:

Bed--fracture bed	Wool strips
Foot board	Impervious material
Portable wash tub	Pins or clips
Sterilize r	Hot water bottles
Hot water	Electric bulbs
Heater	Electric cradles
Wringer	Warm room or ward

SPECIFIC EQUIPMENT DESIREABLE: Portable washing machine, electric heating unit, automatic electric wringer.

The equipment will vary according to the local situation such as:

- A unit for a quarentine ward of a hospital.
- A unit for a general ward of a hospital
- A unit for treatment in a poor home.
- A unit for treatment in a well-to-do home.





(Table III Cont.)

COMPONENTS OF UNIT FOR HOT FOMENTATIONS:

1. Portable washing machine  
Ordinary washtub on a truck with rubber wheels  
Foot delivery unit to raise the foments to level of  
wringer rollers.  
Buckets like scrubwomen use in large buildings
2. A wringer attached to tub  
Automatic electric wringer or foot control
3. Means of keeping water very hot  
Electric heating units with thermostat control
4. Woolen strips and swathes of blanket material
5. Pan for complete foments in a warm compartment  
ready for use.
6. Some poles or sticks like the washer women use or  
long forceps
7. Water proof materials
8. Larger sterilizer to boil fomentations if they are  
used on more than one patient"

1

1. P. Lewins, "Physical Unit Necessary to Carry Out the Kenny Method of Treatment for Poliomyelitis," Illinois Medical Journal, 81: 292, April, 1942.





CHAPTER VII  
THE KENNY METHOD OF TREATMENT OF  
ANTERIOR POLIOMYELITIS

SUMMARY AND CONCLUSIONS OF THE STUDY

The prognosis after an attack of poliomyelitis depends upon the amount of destruction of the anterior horn cells by the virus. The paralysis which follows such an attack is due to:

1. Inflammation which causes toxic products and hemorrhage to accumulate, thus causing pressure on the anterior horn cells. Here, paralysis is temporary in nature for when these products are absorbed, function returns.

2. Malnutrition of anterior horn cells due to surrounding hemorrhage or block of paths of nutrition.

3. Injury of anterior horn cells without complete destruction.

4. Complete destruction of anterior horn cells.

1

It is understandable why in the first three classifications prognosis may be good or fair. However, a physical examination of muscle power paints only a surface picture; the amount of actual damage in the spinal cord is difficult to determine even

1. M. McMillan, Massage and Therapeutic Exercise, Philadelphia and London, W. B. Saunders Company, Third Edition, 1932, p.134.





with electrical stimulation testing. Therefore, actual prognosis cannot be estimated in either the Orthodox or Kenny Method. Yet, it is obvious that some method of grading paralyzed or weak muscles is necessary in order to institute therapy and measure progress of affected muscles.

The treatment of poliomyelitis has changed many times since the beginning of the century. Approximately twenty-five years<sup>1</sup> ago, rest and muscle grading was the approved treatment; some<sup>2</sup> ten years later, the trend was toward underwater exercise; ten<sup>3</sup> years later, complete immobilization and rest was advocated; and at the present time, we have the introduction of the Kenny<sup>4</sup> method of treatment. It has been shown earlier in this study that, although improvements have been made during the years after its inception, muscle testing of the Orthodox system of poliomyelitis is not completely scientific (see **MUSCLE TESTING, CHAPTER IV**).

The orthodox system of muscle reeducation is based upon such a test to determine which muscles are affected. The affected muscles are the flaccid muscles; the opponents are the normal muscles which have normal "tone" but do not have the normal pull of the flaccid muscle to create the equilibrium. The treatment consists of radiant heat, massage, and muscle training which

- 
1. R. W. Lovett, Treatment of Infantile Paralysis.
  2. G. L. Lowman, op. cit.
  3. W. R. MacAusland, Poliomyelitis, Philadelphia, Lea and Febiger, 1937.
  4. J. F. Pohl, E. Kenny, op. cit.





aims to reestablish the impulses in individual muscles (the flaccid muscles). The emphasis is on developing muscle strength, the original test being graded on a "strength" basis. The disease is divided into three stages; the acute stage, when affected muscles are immobilized; the subacute stage, when the above therapy is started; and the chronic stage, which is characterized by braces and continues the physical therapy employed in the subacute stage plus underwater exercises.

Into this lap of complacency, Sister Elizabeth Kenny of Australia dropped a bomb. The orthodox concept of poliomyelitis was all wrong, she claimed. Much discussion and controversy followed, for the concept which she offered was the reverse of the "accepted" theory. However, her tenacity and perseverance led her on to try to convince the medical profession of the value of her concept and treatment for this dreaded disease, infantile paralysis. There have been many who have turned a "deaf ear" to her theory and treatment; however, her results have so impressed observers, who are responsible medical men, that they have publicly announced that Miss Kenny's treatment for infantile paralysis in the acute stage holds more hope for recovery than any other treatment. They state that there is no longer any doubt in their minds that the Kenny treatment relieves pain and stiffness, prevents contractures, and therefore, lessens the tendency of deformity. Thus, by treatment of the disease in the acute stage, a larger percentage of recovered patients is possible.<sup>1</sup>

---

1. Pohl and Kenny, op. cit., p. 8, pp. 343-355.





Sister Kenny's concept of the disease, poliomyelitis, is characterized by: (1) pain; (2) muscle spasm; (3) muscle incoordination, caused by the pain and substitution of muscle function; (4) mental alienation which prevents the patient from using normal muscle function. Her treatment endeavors to:

1. Eliminate muscle spasm.
2. Eliminate "alienation" and restore mental "awareness".
3. Eliminate substitution and incoordination and restore muscle coordination.

She achieves her aims by the following program:

1. The natural rest or "zero" position in bed.
2. Preservation of the "proprioceptive reflexes" by a foot board.
3. The application of hot wet packs (fomentations) to eliminate the muscle spasm and allay pain.
4. The elimination of such orthodox measures of treating poliomyelitis as: the respirator, all splints, and massage.
5. Muscle reeducation which includes:
  - Detection of spasm.
  - Classification and synchronization of muscles.
  - Passive movements.
  - Concentration of active movements on the insertions of muscles and tendons.

According to the Kenny concept, therefore, the disease, poliomyelitis, is manifested by the presence of "spasm"--and not to the presence of "flaccidity;" the affected muscles are the muscles in "spasm," the opponent being on a stretch which, if not treated, will tend to become "alienated". Thus a muscle which is not affected by the disease becomes useless. There is no doubt but that Miss Kenny is greatly influenced by the fund-







amental principle of Sherrington's Reciprocal Innervation.\*

As soon as the diagnosis of poliomyelitis is made, treatment is started at once. The preliminary step is the detection or determination of which muscles are in spasm. To these muscles hot fomentations are applied until the tenderness and spasm have been relieved. Active muscle training is then begun which consists of physiologic motions followed by rhythmic contraction and relaxation of muscles. As the pain and spasm diminish, these movements help relieve the local and systemic congestion, for relaxation of affected muscles and improved circulation release the products which were locked and stagnated therein. Scar tissue may therefore be prevented from forming and limited. The injury to the nervous pathways may also be minimized by early treatment and thus the amount of remaining paralysis limited to the affected muscles of which the anterior horn cells have been completely destroyed by the virus. A study of physiological psychology supports the rationale of making a transition from the idea of early rigid rest and immobilization to start physical therapy immediately after diagnosis. The early elimination of pain and spasm with the Kenny treatment prevents the atrophy of disuse which follows neuromuscular inactivity. The relief of muscular pain also improves the morale of the patient. One

---

\* Sherrington's Reciprocal Innervation. According to Sherrington's principle of reciprocal innervation, contraction of the agonist results in relaxation of the antagonist. This is a form of inhibition when the nerve cells which control the antagonist are restrained. -C. S. Sherrington, Integration of the Nervous System, New Haven, Yale University Press, 1906.



AVFCOM BORD



of the hardships of the former treatment of infantile paralysis has been what seemed to the patient and parent a "do-nothing" policy during the early stages of the disease.

When muscle reeducation is started, its aim is to establish coordination by overcoming "mental alienation". "Mental awareness" is brought about by first rendering healthy muscles inactive (relaxation) and trying to use the paralyzed ones. While physiologic stimuli are carried through by the physiotherapist, the patient's attention is fixed on the insertion of the muscle or tendon being trained in order to correct or prevent substitution of muscle action. The physiotherapist makes stroking maneuvers along the course of the muscle or tendon of this muscle to aid the patient on the area of concentration. Patients are usually treated twice a day and are given one to three contractions per muscle: two passive and one active. Massage is not used.

After having examined the Kenny system in terms of physiological psychology, we are able to understand why observers note that none of the undesirable complications occur. The condition of the skin and circulation is good; back and abdominal muscles, good; and the percentage of contractures and deformities is small. Her patients become more flexible than they were before the onset of the disease. It is likely that with the increasing use of the Kenny method, the percentage of patients reaching the chronic treatment stage of poliomyelitis will be lessened. In the chronic stage, our concept of poliomyelitis has not





been questioned by Sister Kenny. She treats all of her patients with the attitude that all will walk again. When she gives up hope for helping a hopeless case, she turns him over to the orthodox treatment of the chronic stage. Here, braces and supports as well as orthopedic operations are just as necessary as before.

An investigation of the Kenny method of the treatment of infantile paralysis in terms of physiological psychology enables one to understand the foundation of the Kenny concept and treatment in order to evaluate its worth. Physiological psychology is a science which includes physiology, psychology, and neurology. Its investigations have to do with the behavior of Man who possesses a more involved neuromuscular system than the lower animals. These studies of physiological psychology have to do with the nervous system which coordinates and integrates the various parts of the body. The circulatory system may also be considered an integrator of the body for it connects every part<sup>1</sup> with other parts.

The intelligent teaching of a motor skill necessitates a fundamental knowledge of this branch of science. The aim of psychology is to understand the way in which physical stimuli govern behavior; the aim of physiology is to understand the processes which go on within the organism. The normal human being is the product of the blending of both healthy "physiology" and

---

1. C. T. Morgan, Physiological Psychology, New York and London, McGraw-Hill Book Company, Inc., 1943.







healthy "psychology." A scientific method of teaching a motor skill or skills must necessarily rest on the principles of physiological psychology; hence, a sound program of muscle re-education should rest on the sound principles of physiological psychology.

Much criticism of the Kenny method is due to the obscurity of her terms. These term, "proprioception," "mental alienation," "substitution," "incoordination," "muscle consciousness," and "mental awareness," have never been associated with the treatment of poliomyelitis. Much of the controversy has come because many refuse to investigate these terms. What many medical people have forgotten is that the human being is the combination of mind and body, and treating the body alone is not always efficient. Reeducation, as employed by Miss Kenny, is the combination of physiology, psychology, psychotherapy, and physiotherapy. The fact that Miss Kenny is able to efficiently treat these symptoms is an indication of this mind-body relationship in Man. In the Kenny treatment, the patient takes an active part in his education for normal function; his mind as well as his body are called upon to take responsibility for this task.

At this point, the writer must admit that this study, on investigation, could not be covered in the field of physiological psychology alone; for poliomyelitis, being a pathological disease, could not be completely understood and treated by a branch of science which describes the findings of the "normal." The reader will therefore find that while 90% of the Kenny treat-





ment depends upon an understanding of the findings of physiological psychology, the remaining 10% consists of psychotherapy, which treats the abnormal or pathological. Psychotherapy or psychiatry is mental therapeutics which is mind cure by making mental impressions or suggestions.

The outstanding asset of the Kenny treatment is the attitude that lack of function is not necessarily a result of destruction of the anterior horn cells. Miss Kenny claims that inability to use muscles may be due to functional disturbance--breaking of the continuity of nerve impulses through "mental alienation" when the impulse is "stifled", or through "incoordination" when the impulse is directed to wrong channels. Her treatment is aimed at restoring, not muscle strength, but "mental awareness". Muscle testing for determining muscle strength is forbidden because of the danger of encouraging spasm, "alienation", and "incoordination".

Is the Kenny method of the treatment of infantile paralysis physiologically accurate and psychologically sound? A proper<sup>1</sup> physiologically and educationally sound program should:

1. Bring physiological health or nutrition to the muscles themselves.
2. Help the individual develop in coordination.
3. Consider the psychological as well as physiological aspect of the individual's make-up.

The learning of motor skills takes place through sensory controls--kinesthetic, auditory, and visual. Because they improve more efficiently with instruction which prevents trial-and-error

J. B. Nash, Mind Body Relationships, in Interpretations of Physical Education, Vol. I, New York, A. S. Barnes, 1931.





learning by pointing out better methods and avoiding incorrect coordination, we <sup>1</sup>find that the Kenny treatment is educationally sound. The laws of learning are not ignored in this system, and every effort is made to provide an atmosphere which is psychologically wholesome and conducive to learning. One of the outstanding factors of the Kenny treatment is the fact that the patient takes an actively responsible part in his reeducation. His tasks progress from the simple to the more involved. The atmosphere is one of optimism; it is essential to have a hopeful, cheerful atmosphere where reeducation is going on.

Muscular activity is a result of the blending of mind and body. One has only to recall the perfected movements of the well-trained athlete or the precision of the movements of a ballet dancer for illustration of this fact. It follows, therefore, that reeducation of muscular activity should consider the individual as a whole. A program of reeducation should be based upon the foundations which have served the teaching world with success. It is essential that a program of reeducation of muscular activity be based on the sound principles of physiological psychology. The Kenny system treats the individual as a whole, which means treating the psychological as well as the physiological aspect. Everyone agrees that we must aim to control this disease through immunological channels, which today,

---

1. C. T. Morgan, op. cit.





in spite of all our research, we are not able to do. Let us, therefore, be open-minded enough to treat the symptoms of the disease, as suggested by Sister Kenny, for not only do responsible observers commend her results, but comfort is afforded to the pain and malaise of the acute stage. Now, after investigating and analyzing this method, we find that it rests soundly on the findings of physiological psychology and psychotherapy.

Is the Kenny method of treatment educationally sound?

Let us provide a "yardstick" with which to measure the educational soundness of the method under investigation. There are guides which are called "principles of teaching." These principles have developed from various sources: findings from the different branches of science such as anatomy and physiology, psychological laws and theories, and the writings of the experiments and experiences of teachers. From all this data are derived many conclusions or "generalizations." "Fundamentally, a good teaching practice should be based on a sound physiological and psychological basis, should have meaning and significance for the individual, and should provide carry-over interest. These principles may be stated as follows:

1. That method of providing for individual differences is best which guarantees that each pupil shall work up to capacity.
2. Activities should possess interest value and lead to new and more mature interests.
3. In general, learning should progress from wholes to





parts and parts to wholes in this order; parts should always be seen in relationship to wholes.

4. The teacher should not only have attention, but should hold attention and interest. An attempt should be made to "tie in" with a previous lesson.

5. There should be a "warming up" period.

6. It is important to create the proper atmosphere for learning. The pupil (patient) must be viewed as an absorbing organism as well as a reacting one. The teacher must create a type of environment in which the cues, atmosphere, and stimuli are favorable to learning.

7. The teacher should vary techniques with learning.

8. The teacher should develop ingenuity, and an understanding of the pupil (patient)."<sup>1</sup>

9. It is important to remember that kinesiology is based on coordinated muscle activity.

The Kenny treatment allows for differences in pupils (patients). It is absolutely a "must" that the physiotherapist obtain and hold the attention and interest of the patient. But individuals vary in intelligence, temperament, attitude, background, and biological characteristics. Sister Kenny makes mention of the rule that if the patient is not giving complete attention for any reason, the muscle reeducation period should

---

1. A. S. Barr, W. M. Burton, L. T. Brueckner, Supervision, New York, D. Appleton-Century, 1938, p. 426.





be stopped immediately and resumed at another time when the patient is in a more receptive mood. Miss Kenny also makes **provision** for the patient who accidentally performs a motion with a muscle which he was not formerly able to use. Even in such an instance, she advises that the muscle training period stop at this point so that the patient may be left with an encouraged optimism for future accomplishment. Is this not an attempt to "tie in" with a previous lesson? This also creates the proper atmosphere "within" the patient for learning.

A great deal has already been said about the hopeful, cheerful environment of the wards where the Kenny treatment is being given. Thus a healthy environment is provided "about" the patient, which is conducive to learning. Observers tell us that Miss Kenny "gets results." Of course, she gets results; she is a good teacher. Fortunately, every teaching staff possesses some teachers who are able to get results others fail to get. Trial and error is at a minimum because of the precisely technical supervision insisted upon.

On investigation, therefore, we must concede that Sister Kenny has planned a method of reeducation which is educationally sound.

#### ADVANTAGES AND DISADVANTAGES

While it is true that the Kenny treatment takes us a "step forward," it is unfortunate that so many people do not really understand its limitations. Because epidemics vary in intensity from year to year, it is difficult to accurately estimate the





percentage of patients who might have recovered completely with the orthodox method of treatment. However, observers, <sup>\*</sup>competent physicians, who have worked with the orthodox system and are in a position to make comparison, seem convinced of the worth of the Kenny system. They tell us that none of the complications found to occur with the orthodox treatment are found when the Kenny treatment is administered by physiotherapists trained in the technique. Many other physicians throughout the country have recently written articles in which they praise and advise the use of early treatment for poliomyelitis in order to limit the actual amount of damage to the anterior horn cells destroyed by the virus. There are certain conclusions which we are sure of. Patients who receive early treatment have less atrophy, have better muscle tone, and joint motion is more limber than patients treated with splinting. Whether the contractions and deformities, which are prevented by the Kenny treatment, will remain permanently prevented can only be proved with observation of these patients over a longer period of time.

The writer was in a position to observe an experimental group which has since been reported upon. <sup>1</sup>The treatment of infantile paralysis in the acute stage was carried out at the Willard Parker Hospital in New York City in 1941. A summary of

---

\* The Minneapolis group: Drs. W. Cole, M. Knapp, J. Pohl.  
 1. M. I. Daly, J. Greenbaum, E. T. Reilly, A. M. Weiss, P. M. Stimson, "The Early Treatment of Poliomyelitis," Journal American Medical Association, 118: 1433-1443, April 25, 1942.





the authors findings are:

1. Spasm in uninvolved as well as in affected muscles was noted in all cases.
2. The hot fomentations alleviated the pain in from one to three days.
3. All patients treated with the Kenny treatment were more comfortable, in general, than those treated with the orthodox treatment. Sedatives were hardly used. Older patients were able to help evaluate the treatment by commenting on the amount of comfort derived.
4. The condition of the skin and muscles was excellent.
5. Complete range of motion was possible weeks and months earlier than would have been with the orthodox treatment of immobilization.
6. While giving the passive motions, the physiotherapist was able to feel "life" or tone in the muscle even before the patient.
7. Since the patients were treated from the onset of the disease, there was a very small percentage of atrophy and deformity present.

The authors concluded, therefore, that:

1. Treatment should be started immediately after diagnosis of poliomyelitis by detecting spasm and treating same.
2. Treatment in poliomyelitis should be directed to the symptoms of the disease.
3. The bulbar type of poliomyelitis is well taken care







of in the Kenny method of treatment.

4. In comparing the orthodox method of treatment with the Kenny treatment, there is no doubt but that the latter is the treatment for poliomyelitis.

All who were familiar with the orthodox treatment and saw this group treated with the Kenny treatment--the writer included--agreed that the latter leads patients to a more rapid complete recovery with less deformity, contractures, and atrophy. Not only are the results better but also the acute stage of the disease is not so unbearable, for patients are better off in comfort. This is a very important consideration. The authors of this study based their observations on all aspects of the disease: the physical conditions of the muscles, the circulation and metabolism, the general physical and mental conditions, the central and sympathetic systems, and the psychological reactions of the patients.

Thus we find that observers, who are in positions to evaluate, have commented on the benefits derived from the Kenny treatment. Not only is there more comfort and cheerfulness during the acute phase of the disease, but also there are actually fewer contractures and deformities. Not only is full range of joint motion present in all cases--no matter how severely affected the patient may be--but also patients are even more limber than they were before they contracted the disease. Even spinal deformities are not to be found. Cole and Knapp (Minneapolis Group) tell us that every case has a milder degree of





paralysis than would be expected. "Those afflicted with the disease stand to benefit in either case, and that, after all, is the objective toward which we are all striving."<sup>1</sup>

All agree that no harm has come from use of the Kenny treatment and that its application of hot packs in the acute stage makes it accessible to all. Water is so universally present that treatment in a farmhouse may thus be instituted when symptomatic treatment can be of such benefit both physiologically and psychologically. It has become apparent to those who have observed the Kenny method and have bothered to investigate its worth that immobilization in poliomyelitis is "on its way out." Sister Kenny has knocked the medical profession out of its complacency and has stimulated research. She has brought to the foreground the fact that a physiological change takes place in muscles affected by poliomyelitis. She has also reminded the medical profession that we must treat the psychological aspect as well as the physiological aspect of an illness. Yes, Sister Kenny has made an invaluable contribution to the treatment of acute anterior poliomyelitis. Of course we must aim to attack this disease at its source by immunology, but until that time, we must be willing to go forward by treating the symptoms of the disease if that will help the victims.

Paradoxical though it may seem, it is unfortunate, both for Sister Kenny and the public, that the Kenny treatment has received

1. Pohl and Kenny, op. cit., p. 355. (Quoted from Miland E. Knapp, M. D.)







so much newspaper publicity. The layman has built up an idea that the Kenny treatment is the "panacea" for infantile paralysis and that there are no cases of paralysis when the "Sister Kenny treatment" is administered. As has been stated, although the Kenny treatment has proved itself valuable, there will still be cases of paralysis which will require braces and orthopedic surgery. Also, although it is true that we hope the percentage of contractures, deformities, and paralysis will be smaller, we cannot be sure of our conclusions until follow-up through the coming years verifies our opinions. Most of the medical profession refused to "listen" to Sister Kenny--many saying that her concept and treatment were all wrong and of no value. The publicity of her personality traits and the dramatic attempts of writers and reporters to glamorize her, has only widened the breach. The profession claims this publicity has "misinformed the public." However, we all must acknowledge the fact that she has stimulated the profession to improve the treatment for poliomyelitis.

But since the Kenny method does not permit routine testing of muscles, how can we evaluate the treatment accurately? Although muscle testing is not 100% accurate, it is the only method we have of estimating the progress of a patient. There are many advantages of keeping record of patients through the years. It is difficult to accept a program of reeducation without some scientific method of examination. Sister Kenny advises against moving the patient and recommends only an analysis by inspection





and palpation of the muscle spasm. Cannot some compromise be effected?

The Kenny treatment entails a great deal of expense; in fact, some estimate it to be five times as expensive as the so-called orthodox treatment.<sup>1</sup> The treatment requires highly trained personnel: physiotherapists, nurses, and attendants. Much time and great patience are also necessary requisites. However, there are few of us who begrudge these victims of poliomyelitis this chance to live a normal active life. Perhaps, an electric apparatus invention could be manufactured to relieve the drudgery of the hot packs.

Regardless of whether we admire or condemn Sister Kenny--her theories or attitudes--the methods of the Kenny treatment are based on the solid rock foundation of the findings of physiological psychology, and are definitely established until something better is found. All observers agree that Miss Kenny has stimulated research to reevaluate the past treatment of poliomyelitis and to improve upon it. She has brought to our attention the value of early treatment and the importance of physiotherapy in the treatment of infantile paralysis. It is not contended by the writer that physiotherapy will solve the problems of the disease, poliomyelitis. She agrees that control will be effected through prevention rather than cure. Let us, therefore, administer the best treatment possible--but let us direct our efforts toward immunologic research.

---

1. N. Ransahoff, Journal of Bone and Joint Diseases, 26:99-102, January 1944.





## BIBLIOGRAPHY

### Magazine Articles

Aycock, W. L., "Epidemiology of Poliomyelitis," International Bulletin for Economics, Medical Research and Public Hygiene, National Foundation for Infantile Paralysis, Volume A 40, 1939.

Bowditch, I., "Note on the Nature of Nerve Force," Journal of Physiology, 6: 133, 1885.

Brunnstrom, S., "Muscle Group Testing," The Physiotherapy Review, Volume 21, January-February, 1941.

Daly, M. I., Greenbaum, J., Reilly, E. T., Weiss, A. M., Stimson, P. M., "The Early Treatment of Poliomyelitis," Journal American Medical Association, 118: 1433-1443, April 25, 1942.

Draper, E., "An Emergency Plan in High Incidence Poliomyelitis," Physiotherapy Review, Volume 24, No. 3, p. 96.

Eccles, J. C., Sherrington, C. S., "Numbers and Contractions Values of Individual Motor Units Examined in Some Muscles of the Limb," Proceedings, Royal Society Series B, London, 106: 326, June 2, 1930.

Fairbanks, H. A. T., Macdonald Critchley, Lloyd, E. I., Lumbrinudi, C., Elmshe, M. C., Grey, G. M., West, H. O., "Report of the Committee Appointed to Observe the Kenny Method of Treatment for Paralysis at London," The Medical Journal of Australia, Volume II, pp. 1133-1137, December 31, 1938.





(Bibliography cont. -2-)

Haggqvist, F., "The Question of Spastic Paralysis," International Bulletin for Economics, Medical Research and Public Hygiene, Volume A 40, 1939.

Hall, V. E., Schamp, H. M., Brown, G. E., Davis, M. N., "Effects of Kenny Fomentations on Strength of Voluntary Muscular Contractions in Man," Archives of Physical Therapy, 25: 96-99, February, 1944.

Hansson, K. G., Troedsson, B. S., Schwartzkopf, E., "Electromyographic Studies in Poliomyelitis," Archives Physical Therapy, 23: 261-266, May, 1942.

Harmon, P. H.; "Geographical and Racial Incidence of Poliomyelitis," International Bulletin for Economics, Medical Research, and Public Hygiene, Volume A 40, 1939.

Hipps, H. E., "Muscle Pathology in Anterior Poliomyelitis, Its Relation to Function," Southern Medical Journal, 34: 135, February, 1941.

Kovacs, R., "Electrotherapy in Infantile Paralysis," International Bulletin for Economics, Medical Research and Public Hygiene, Volume A 40, 1939.

Jacobson, E., "Electrical Measurements of Neuro-muscular States During Mental Activities," American Journal of Physiology:

- I. "Imagination of Movement Involving Skeletal Muscle," 91: 567, 1930.
- II. "Imagination and Recollection of Various Muscular Acts," 94: 22, 1930.
- III. "Visual Imagination and Recollection," 95: 694, 1930.
- IV. "Evidence of Contracting Specific Muscles During Imagination," 95: 703, 1930.
- V. "Variation of Specific Muscles Contracting During Imagination," 96: 115, 1931.
- V I. "A Note on Mental Activities Concerning An Amputated Limb," 96: 122, 1931.
- VII. "Imagination, Recollection and Abstract Thinking Involving the Speech Musculature," 97: 200, 1931.





(Bibliography cont. -3-)

Kabat, H., Knapp, M. E., "The Mechanism of Muscle Spasm in Poliomyelitis," Journal of Pediatrics, 24: 123-137, February, 1944.

Kendall, H. O., Kendall, F. P., "Care During Recovery Period of Paralytic Poliomyelitis," Public Health Bulletin, No. 242, United States Government Printing Office, Washington, D. C., 1939.

Kenny Method of Treatment in the Acute Peripheral Manifestations of Infantile Paralysis," Editorial, Journal American Medical Association, 117: 2171-2172, December 20, 1941.

Lewins, P., "The Kenny Treatment of Poliomyelitis," Illinois Medical Journal, 81: 281, April 1942.

Lovett, R. W., Martin, E. G., "Certain Aspects in Infantile Paralysis With a Description of a Method of Muscle Testing," Journal American Medical Association, Vol. LXVI, No. 10, pp. 729-733, 1916.

\_\_\_\_\_, "The Muscle Test for Infantile Paralysis, A Description of the Technique," American Journal Orthopedic Surgery, July, 1916.

Martin, E. G., Lacey, W. H., "Vasomotor Reflexes from Threshold Stimulation," American Journal of Physiology, Volume XXXIII, p. 212, 1914.

Neal, J. B., "Present Day Knowledge of Poliomyelitis," International Bulletin for Economics, Medical Research, and Public Hygiene, Volume A 40, 1939.

O'Connor, B., Introduction, The International Bulletin for Economics, Medical Research, and Public Hygiene, Volume A 40, 1939.





## (Bibliography cont. -4-)

Ober, F. R., "Early Management of Poliomyelitis and the Kenny Treatment," Connecticut State Medical Journal, 7: 16-18, January, 1943.

Ransahoff, N., Journal of Bone and Joint Diseases, 26 : 99-102, January, 1944.

Schwartz, R. P., Bouman, H. D., "Muscle Spasm in the Acute Stage of Infantile Paralysis as Indicated by Recorded Action Currents Potentials," Journal American Medical Association, 119: 923-926, July 18, 1942.

\_\_\_\_\_, "Degree, Extent and Mechanism of Muscle Spasm in Infantile Paralysis," New York State Medical Journal, 44: 147-153, January 15, 1944.

Steindler, A., Russin, L. A., Sheplan, L., Walkin, V., "Recent Changes in the Concept of the Treatment of Poliomyelitis," Archives Physical Therapy, 23: 325-331, June, 1942.

Stone, S., "Artificial Fever and Vitamin Therapy in the Treatment of Anterior Poliomyelitis," Archives Physical Therapy, 24: 350-361, June, 1943.

Tilney F., "The Present Management of the Poliomyelitis Epidemic in New York City," New York Medical Journal, 104: 1221, December 23, 1916.

Toomey, J. A., "Correspondence," Journal American Medical Association, 126: 49, September 2, 1944.

Toomey, J. A., Takacs, W. S., "Ultra Violet Irradiation of Blood in the Treatment of Experimental Poliomyelitis," American Journal of Diseases of Children, 66: 605-606, December, 1943.

Toomey, J. A., "Early Treatment of Poliomyelitis," Journal of Pediatrics, 21: 353, September, 1942.





(Bibliography cont. -5-)

Weiss, P., "Self-differentiation of the Basic Patterns of Coordination," Comparative Psychology Monographs, Volume 17, No. 4, Serial No. 88, Baltimore, Md., The Williams and Wilkins Co., September, 1941.

Wickman I., "Acute Poliomyelitis," Nervous and Mental Diseases Monograph, Series No. 16, 1913.

Wohlfart, G., Swank, R. L., "Pathology of Amyotrophic Lateral Sclerosis: Fiber Analysis of the Ventral Horn Roots and Pyramidal Tracts of the Spinal Cord," Archives Neurology and Psychiatry, 46: 783, November, 1941





(Bibliography cont. -6-)

# Books

Association for Research in Nervous and Mental Disease,  
Infections of the Central Nervous System, An Investiga-  
tion of the Most Recent Advances, Philadelphia, Williams  
and Wilkins Co., 1932.

Bacon, Francis, Novum Organum.

Barr, A. S., Burton, W. M., Brueckner, L. T., Supervision,  
New York, D. Appleton-Century, 1938.

Beever, C. E., The Croonian Lectures on Muscular Movements  
and their Representation in the Nervous System, London,  
Adlard and Son, 1904.

Cannon, W. B., Bodily Changes in Pain, Hunger, Fear, and  
Rage, New York, D. Appleton-Century, 1929.

\_\_\_\_\_, The Wisdom of the Body, New York, Norton  
Press, 1932.

Clark, P. F., Armstrong, C., Rivers, T. M., Goodpasture,  
E. W., Paul, J. R., Ober, F. R., Infantile Paralysis,  
A Symposium Delivered at Vanderbilt University, April,  
1941.

Darwin, C. R., Expression of Emotion in Man and Animals,  
New York, D. Appleton-Century, 1905.

Draper, G., Acute Poliomyelitis, Philadelphia, P. Blakiston's  
Son & Co., 1917.

Gates, A. I., Psychology for Students of Education, New York,  
Macmillan, 1930.

Gray's Anatomy.

Griffith, C. L., An Introduction to Applied Psychology,  
New York, The Macmillan Co., 1934.

Kellogg, J. H., Rational Hydrotherapy, Second edition, Phila.,  
F. A. Davis Company, 1904.

Kenny, Elizabeth, And They Shall Walk, New York, Dodd, Mead,  
1944.

\_\_\_\_\_, Infantile Paralysis in the Acute Stage,  
Minneapolis, Minn., The Bruce Publishing Co., 1941.





## (Bibliography cont. -7)

- Kovacs, R., Electrotherapy and Light Therapy, Second edition, Philadelphia, Lea and Febiger, 1935.
- Ladd, G. T., Woodworth, R. S., The Elements of Physiological Psychology, Second edition, New York, Charles Scribner's Sons, 1911.
- Legg, A. T., Merrill, J. B., Physical Therapy in Poliomyelitis, Principles and Practices of Physical Therapy, Hagerstown, Maryland, Prior Co., 1932.
- Lovett, R. W., The Treatment of Infantile Paralysis, Second edition, Philadelphia, P. Blakiston's Son and Co., 1917.
- Lowman, G. L., Technique of Underwater Gymnastics, Los Angeles, Cal., American Publications, Inc.
- MacAusland, W. R., Poliomyelitis, Philadelphia, Lea and Febiger, 1937.
- Morgan, C. T., Physiological Psychology, New York and London, McGraw-Hill Book Company, Inc., 1943.
- Morgan J. B., Gilliland, A. R., An Introduction to Psychology, New York, The Macmillan Co., 1927.
- Moss, F. A., Applications of Psychology, Boston, Houghton Mifflin, 1929.
- Muse, M., A Textbook of Psychology, Fourth Edition, Philadelphia and London, W. B. Saunders Co., 1939.
- Nash, J. B., Mind Body Relationships, in Interpretations of Physical Education, Vol. I, New York, A. S. Barnes, 1931.
- Pohl, J. F., Kenny, E., The Kenny Concept of Infantile Paralysis, Minneapolis, Minn., Bruce Publishing Co., 1943.
- Schaeffer, M., Muckenfuss, R. W., Experimental Poliomyelitis, New York, National Foundation for Infantile Paralysis, 1940.
- Sherrington, C. S., Integration Action of the Nervous System, New Haven, Yale University Press, 1906.
- Trow, W. C., Introduction to Educational Psychology, Boston, Houghton Mifflin, 1937.







(Bibliography cont. -8-)

Walsh, J. J., Psychotherapy, New York, D. Appleton-Century Co., 1912.

Wiersma, C. A. G., The Efferent Innervation of Muscle, Biological Symposia, Vol. III, Lancaster, Pa., The Jaques Cattell Press, 1941.

Additional References -Books

Freeman, E., Social Psychology, New York, Henry Holt & Co., 1937.

Freeman, G. L. Introduction to Physiological Psychology, New York, The Ronald Press Co., 1934.

McMillan, M., Massage and Therapeutic Exercise, Third Edition, Philadelphia, W. B. Saunders Co., 1932.

Warren, H. C., Carmichael, L., Elements of Human Psychology, Boston, Houghton Mifflin Co., 1930.



(1) (2) (3) (4) (5) (6) (7) (8) (9) (10)

1. General 2. Particulars 3. Notes 4. References 5. Index

6. Tables 7. Diagrams 8. Formulas 9. Equations 10. Conclusions

11. Summary 12. Appendix 13. Glossary 14. Index

15. References 16. Notes 17. Tables 18. Diagrams 19. Formulas

20. Equations 21. Conclusions 22. Summary 23. Appendix 24. Glossary

25. Index 26. References 27. Notes 28. Tables 29. Diagrams

30. Formulas 31. Equations 32. Conclusions 33. Summary 34. Appendix



Date Due  
Date Labeled

12 1946  
18 1949

Library Bureau Cat. no. 1138

BOSTON UNIVERSITY



1 1719 02479 5413

Ed.

Stored

Service  
Paper  
Mezer, S.L.  
1945

Mezer, S.L.

Investigation of the  
Kenny method ....

m. gaudet

DEC 19 1945

M. Hanbury

MAR 20 1946

M. Hart

OCT 1945

Cecil

Ed.

Service  
Paper  
Mezer, S.L.  
1945

Stored

ACCOPRESS BINDER

BFS 250-P7 EMB.

MANUFACTURED BY

ACCO PRODUCTS, INC.  
LONG ISLAND CITY, N. Y., U.S.A.



